The Journal of heredity

American Genetic Association

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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

JANUARY, 1918

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AMERICAN·GENETIC·ASSOCIATION
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WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, coöperative in nature. It is devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

It owns the JOURNAL OF HEREDITY, which is published monthly and sent free to each member.

REQUIREMENTS FOR MEMBERSHIP

Membership is composed of men of science, teachers, publicists, physicians, clergymen, parents, students, horticulturists and breeders of live stock, etc., throughout the world.

Subject to the approval of the council, any person interested in the improvement of the human race or the creation of better varieties of plants and animals, is eligible for membership.

The secretary will be glad to correspond with those interested, and to send a copy of the magazine for examination.

Annual dues, giving the right to attend all meetings and receive the JOURNAL OF HEREDITY, are $2; life membership is $50.

If you want to become a member, or if you know anyone who you think is eligible for membership, write to

THE AMERICAN GENETIC ASSOCIATION

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The Journal of Heredity

(Formerly the American Breeders' Magazine)

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The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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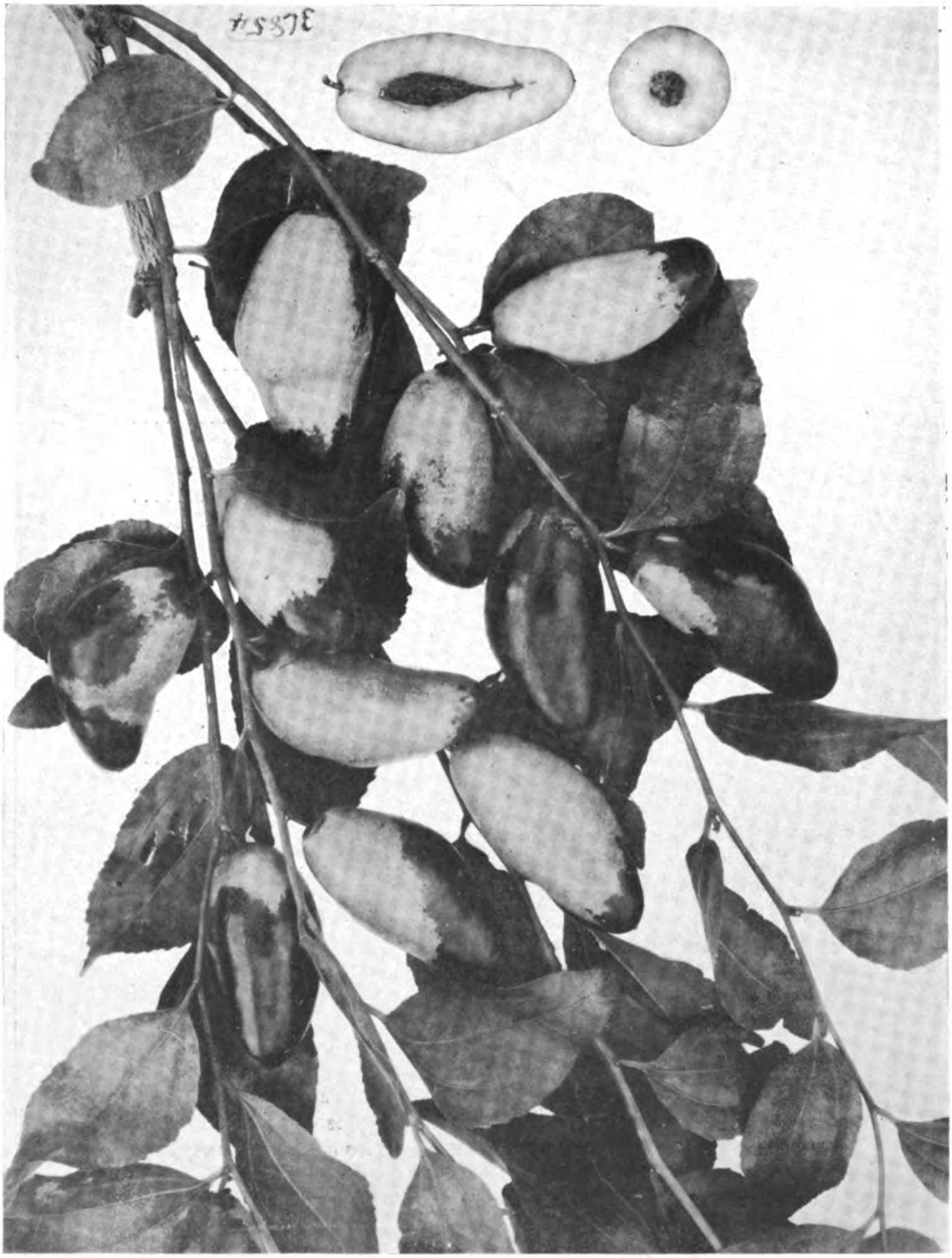


THE TOOTH JUJUBE, AN UNUSUALLY GOOD VARIETY

Jujube fruits natural size, from the U. S. Plant Introduction Field Station, at Chico, California. This variety is grown in Peking gardens under the name "Yu tsao" meaning, "Tooth jujube" on account of the form and shape of the fruit. The quality of the fresh fruit, when ripe, is very good indeed. It processes well, and is one of the best flavored grafted sorts that have so far fruited in this country. S. P. I. 36854. Photograph by P. H. Dorsett, Oct. 1917. (Frontispiece.)

THE GRAFTED JUJUBE OF CHINA

A Deciduous Hardy Fruit Tree That Flowers so Late in the Spring That Its Blooms Are Never Caught by the Frost

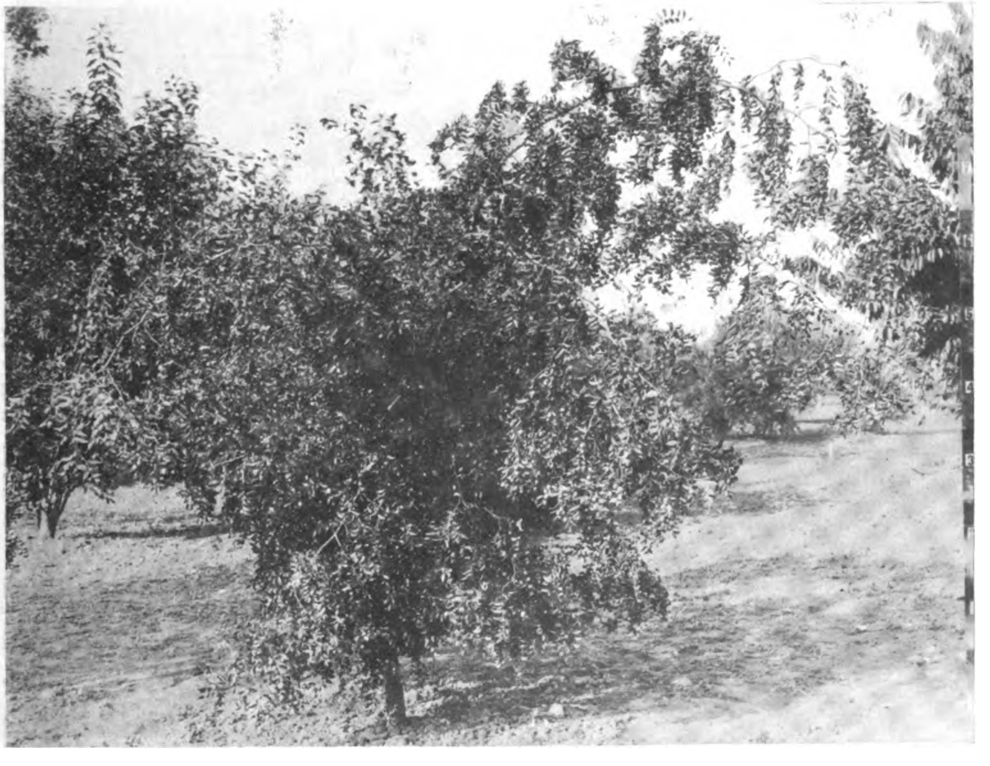
David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

THE word jujube is connected in the public mind with jujube paste and jujube lozenges, which formerly were in vogue as a cough remedy. These lozenges often had nothing whatever to do with the jujube, being made of gum arabic and sugar.

The Chinese jujube is practically a newly discovered fruit tree, so far as American agriculture is concerned; for although there are seedling jujubes in various public parks and door yards, which doubtless are the result of early introductions, through missionaries in China, the importation of the large fruited, grafted Chinese varieties was only begun in 1906.

While some of the early introduced seeds have now grown into large sized trees and borne crops of small fruits which are of good flavor, these fruits have been too small to attract the seri-



JUJUBE TREE WEIGHTED DOWN WITH FRUIT

Nearby view of a jujube tree in the test orchard at the U. S. Plant Introduction Field Station, Chico, California. The limbs and main branches of the tree are weighted down with fruit. There has not been a single failure of a crop of jujubes at the station since the trees were old enough to bear fruit something over six years ago. Photograph by P. H. Dorsett, Oct. 1917. (Fig. 1.)

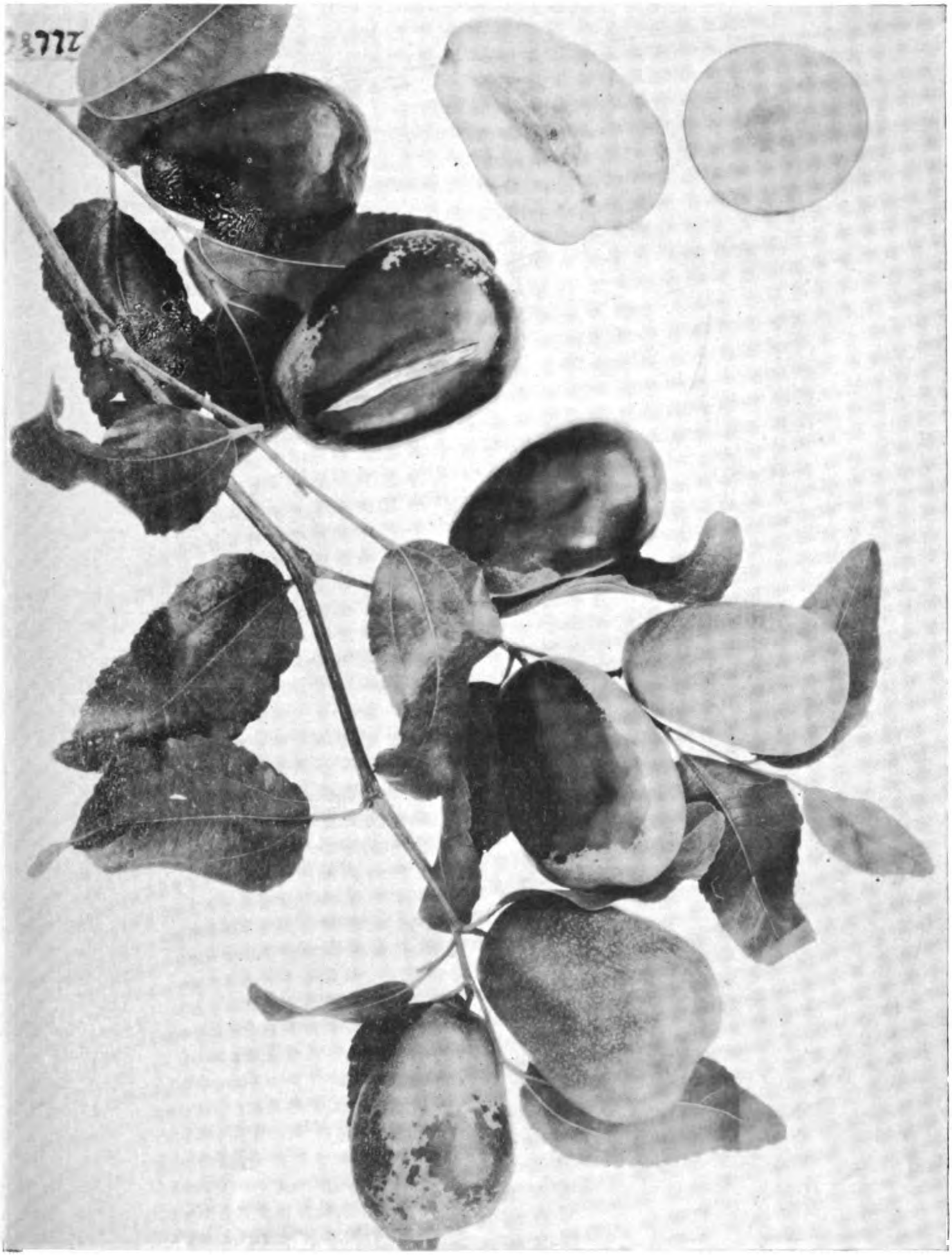
JUJUBE TREE BEARING BEFORE ONE YEAR OLD

A young jujube plant in nursery row, produced from a bench graft of January, 1917. This small tree less than a year old is bearing a very good crop of fine large fruit. This plant is especially interesting for the reason that the fruit is borne on hard wood branches that are not deciduous; while generally on older trees the fruit is born on slender deciduous branches of the current season's growth. Photograph by P. H. Dorsett, Oct. 1917. Chico gardens. (Fig. 2.)

ous attention of horticulturists. With the bearing in this country of the large fruited Chinese varieties, which were introduced in 1906, the jujube appears in quite a different light—one worthy of the serious consideraton of amateur and practical horticulturists living in those regions where they can be grown successfully.

The claims of this new fruit tree may be briefly stated as follows, judging from the limited experience which this Office has had with it in various parts of the country, but without any pretence of being a complete statement of its possibilities, of which it is one of the objects of the distribution of plants to find out:

The jujube is a medium-sized spiny tree which grows to be forty or more years old. Its rate of growth depends upon the climate in which it is grown. In New England, or regions with cool summers, it makes a very slow growth; whereas in northern California, where the thermometer goes to 120°F., it grows rapidly. No weather appears to be too hot for it, and so far as resistance to cold is concerned, it has withstood temperatures of 22° F. below zero without injury. Just how much lower winter temperatures it will withstand, has not yet been determined. The range of territory, however, over which it is likely to prove a success as a fruit tree, will be probably limited more by the warmth and length of the summer season than by the severity of the winter. The whole southwest, with the exception of the elevated areas where cold summer nights occur and those portions of the Mississippi Valley, where the humidity and rainfall are not too great, as well as the drier portions



FRUITING BRANCH OF THE MELTING JUJUBE

This variety is known in China under the name "Lang tsao." Frank N. Meyer who introduced it says that it might be called "The melting jujube." The fruit when ripe is crisp and pleasing to the taste. The trees bear heavily and the fruit are excellent when processed. No. 22686 natural size. Photograph by P. H. Dorsett, Oct. 1917. (Fig. 3.)

DECIDUOUS FLOWERING BRANCHES

Showing deciduous flowering branches of the jujube natural size. From a tree in the test orchard at the U. S. Plant Introduction Field Station, Chico, Cal., May, 1916. Photograph by P. H. Dorsett. (Fig. 4.)

of the Atlantic Coast states, appear promising regions in which to test the jujube. It enjoys brilliant sunshine, dry weather, and long, intensely hot summers, and although it will form good sized trees under other conditions, it appears to require these climatic factors to make it fruit early in its life, regularly, and abundantly.

As regards soil conditions, it appears to withstand slight amounts of alkali and to grow with special vigor on the loess, or wind drifted soil formations of China. As this formation composes large areas of north-western Iowa, it might be tested there, though the climate may prove too severe for it. Under irrigation in northern California, and without irrigation in central Texas, the trees have grown luxuriantly and fruited abundantly. In the warm humid summer region of Maryland, seedling trees have grown well, but fruited sparingly and irregularly. In Georgia, old seedling jujubes have fruited well.

The trees have the characteristic habit of starting into growth slowly in the spring, which protects them from late spring frosts. The flowers are produced on the new growth of slender branches, and in this respect the jujube resembles the grape; with this difference, however, the new bearing canes of the grape are not deciduous; whereas the slender bearing twigs of the jujube as a rule fall after the first hard frosts, and soon after the leaves have fallen.

The peach, almond and apricot bloom in northern California in February and March whereas the Chinese jujube blooms in May and June when all danger from frost is long over. Only those who have lost a fruit crop from frost can appreciate the advantage of

this late blooming habit. Since trees in California and Texas first fruited, over six years ago, they have never failed to produce good crops.

The fruits of the wild jujube, which are produced in great abundance, are only about one-half inch in diameter, but some of the grafted Chinese varieties are as large as the French prune. They have a curious way of ripening, which gives a mottled appearance to the half ripe fruit. Brown spots appear upon the perfectly green fruit and these spread gradually until they meet and the whole fruit becomes chestnut brown. Shortly after the fruits turn brown they begin to shrivel and lose their crispness and become spongy. These dried jujubes form an important article of commerce in China, and deserve to be studied here.

When not over-ripe the jujubes have a sweet delicate flavor, quite unlike any other fruit, and a texture and crispness which reminds one of a crabapple. One becomes fond of them even though they cannot be said to compare with other fresh fruits like the pear or apple. The ripe fruit contains a high per cent of cane sugar—as much as 20%.

It is as a prepared or candied fruit that the jujube deserves to be most seriously considered by American horticulturists, for when processed as they are by the Chinese, they compare favorably with the Persian date in flavor and palatability, and to the unobserving, they might be mistaken for dates; in fact Europeans in China have persistently confused them with the fruit of the date palm.

The preparation of candied jujubes is a simple culinary process consisting of boiling the ripe fruits for two hours in a thick syrup consisting of one pound of granulated sugar to one-half cupful of hot water. Three pounds of jujubes are put into this syrup in a low preserving kettle and boiled slowly for two hours, and are then lifted out with a strainer and dried in the sun or in a heated oven. Some of the methods in use in China are more complicated than the above, honey being used as well as sugar, and they make a better product.

Mr. Frank N. Meyer, who has seen the process in China, reports that the practice is to dry the jujube fruits, and to boil them three different times in sugar syrup, and afterwards in honey and sugar. Then, by slashing the skins after the second boiling with a special tool, which cuts the skin into narrow longitudinal strips, a remarkable confection is produced which is comparable with the best Algerian or Persian Gulf date.

What will be the fate of the Chinese grafted jubube in America it is impossible to predict, but it has shown its possibilities to hundreds of American horticulturists and their ingenuity and enterprise may be depended upon to develop its culture in the big comprehensive way in which they have developed the grape fruit, the olive, the date, the avocado and other fruits new to America.

An Outline of Applied Sociology

OUTLINE OF APPLIED SOCIOLOGY, by Henry Pratt Fairchild, Ph.D., assistant professor of the science of society in Yale University. Pp. 353, price $1.75. New York, the Macmillan Company, 66 Fifth avenue, 1916.

Dr. Fairchild discusses eugenics and feminism together in a chapter entitled "Revolutionary Schemes." He sees much value in such work as the elimination of the feebleminded, but thinks constructive eugenics will appeal least to those who need it most. "It must be observed, however," he says, "that the eugenics movement, as far as its leaders are concerned, makes no extreme claims, nor advocates policies which it is not prepared to support. In this it differs diametrically from feminism. Eugenics is thoroughly scientific." Dr. Fairchild is probably open to the criticism of construing eugenics too narrowly; as a fact, most of the hundred pages he devotes to questions of the family and population may be said to deal with eugenics. This part of the work will be of great value to eugenists, for it is clear, sensible, and interesting.

TRACING YOUR ANCESTORS

Genealogy not a Fad, but a Study of Importance to Every Individual—How to Investigate a Family History[1]

SYSTEMATIC study of ancestry has nowhere reached the development that it has in the United States. This is especially true in New England and in those sections most influenced by New England. The average American who claims an ancestry reaching back to pre-Revolutionary times is very likely to know a great deal about his family history, and is inclined to learn all he can. This is true of our people, whether they come of New England stock or of families who settled in the middle and southern states. The advent from various parts of the world during the past quarter century of people, who are of different race affiliations, has tended to strengthen in the American of American lineage his interest and pride in his own forbears. Whatever the recent immigrant may have contributed toward the material wealth of the country, or to its institutions—and his influence has been greater than is realized—the true American remembers that it was his ancestors who created this nation, and while he is willing to share largely with the new comer, he is usually anxious that his children shall know that they are descended from several generations of Colonial stock.

This pride of ancestry has been found worthy of emulation by the descendants of the more intelligent class of emigrants, and the great advance in the study of eugenics has won many persons to an interest in genealogy, who hitherto had regarded "ancestor worship" as a mere fad. People have come to appreciate the fact that it is not a false pride which has led to the collection of data concerning one's ancestry and connection, but a very sensible and practical desire to learn the nature and source of our various characteristics, worthy or otherwise. The study of genealogy in connection with eugenics bids fair to solve many a problem of the future. Forewarned is forearmed.

WHAT GENEALOGY IS

Genealogy is something more than the mere collection of names and dates. It should be a study of the individual and of the family group to which the individual belonged. Uncle and nephew may be more nearly allied in family traits than father and son. Hence one must include in his ancestral scheme the descendants for one or more generations of the common ancestor in each generation. Also, as each individual inherits from two parents, and these parents from their parents, the investigation must be extended sufficiently to comprise at least four generations in every line of ancestry. Certain dominant characteristics will be found to persevere in a given family, and it is that family line which will probably afford the most interest, whether it be the paternal line or some line of one of the four grandparents. The accident of a name does not determine the dominant family traits. The individual is a mosaic rather than a blend. Opportunity is, of course, a controlling factor, whether accidental or established by persistent effort.

Assuming an interest, dormant or active, in family history, the fact remains that very few persons have the information needed to enable them to make a systematic investigation. To such as have access to some of our large,

[1]The manuscript of this article some time since was given to the Editor of the JOURNAL OF HEREDITY by Eben Putnam, formerly editor of the *Genealogical Magazine* (now Capt., 2d M. R. C., in active service), with permission to make use of such portions as seemed of interest. The whole appeared of interest, and hence has been printed under the above caption. Captain Putnam was one of the first among American genealogists to appreciate the importance of genealogy to eugenics, and of preserving records of transmission of hereditary characteristics. He received an award at the U. C. E. in 1892 for his systems for collecting and arranging information.—EDITOR.

well-equipped libraries, opportunity is afforded to procure the information needed to begin a preliminary study, for there have been several books and a number of contributions to genealogical magazines which aim to guide the beginner. It is unfortunate, however, that the greater number, in fact most libraries, have failed to place such works on their shelves. The beginner in genealogy is therefore entirely at sea how to go about collecting the data he needs to form an intelligent foundation for the study of his ancestry. Yet the data are really nearly always ready at hand, or readily accessible if the right steps are taken.

The first step is to arrange in a systematic manner what information one already has regarding the family. There are a number of publications especially designed to record such data. Any up-to-date bookseller can procure these publications. But as a matter of fact the best system is home made. Later, when the material is in hand, verified, arranged, it can be transferred to some specially designed book.

HOW TO CLASSIFY DATA

The simplest method is to take a sheet of paper, of letter size, and midway in the left margin enter the name of the person whose ancestry is to be studied. At one-quarter the distance from the top, and about the same distance from the left margin, write the name of the father, and directly under his name and one-quarter the distance from the bottom write the name of the mother. Join these names by a bracket. Under each name write the date and place of birth, the date and place of death, and under the mother's name the place and date of marriage. Under the father's name write his occupation or profession, his titles if any, and other brief notes if there is room. Now make a third column, and write the names of the parents of father and of mother, joining each pair as before, and taking care that the distances between the names are equal. In a fourth column write the names of the great grandparents, joining each couple with a bracket. This last column will contain eight names, and will be at the very right of the sheet. Under each name write the date and place of birth, death, etc., and under the wife's name the date and place of her marriage. This sheet now contains the names of every ancestor in three generations of the person whose name was first written. It carries the names of fifteen individuals. Take eight sheets of the same size as the first. At the left of each sheet write the name of one of the great grandparents, and duplicate for that person the record for his or her ancestors in the same fashion as on sheet No. 1. When complete, this series of nine sheets will show seven full generations of ancestry of the person whose name was first written on Sheet No. 1. Such a record, if complete, is in itself a very creditable performance, and few people can make up such a record without extensive research.

As the average American of pre-Revolutionary ancestry is of the eighth or ninth, and often of the tenth generation from the emigrant ancestor, a third series of sheets will be required to show all of these ancestors. In the fourth generation appear eight ancestors. In the seventh generation there were sixty-four ancestors, and in the tenth generation there would be 512 ancestors. It is very probable that in one or more instances cousins will be found marrying, and hence the actual number of different individuals will be less than that estimated. In this connection it should be asserted that the often repeated statement that if the lines of everyone were extended back for a certain number of generations it would result in proving that all persons inherited more or less the same ancestry, is not the truth, unless, of course, we trace back to a common progenitor. The fact is, that people of one class or of one community marry among themselves, and in the community it is usually people of the same class who intermarry. Hence, while it may be true that a thousand years ago every yeoman in a certain village or even a larger district may be claimed as a common ancestor by those people who have remained in about the same social position, it is not the fact that every inhabitant in that district

can be claimed as a common ancestor by those people. The families of merchants married with other merchants, or with persons of less wealth but higher rank perhaps, the families of clergy with sons and daughters of clergymen or their connections, of nobles with nobles, etc. So it might be that the descendants of a swineherd of King Alfred's time never married out of their own circle unless it happened that they were of exceptional ability, or that they moved to some other district or country. It is probable that the blood of the higher class such as nobles is much more widely distributed in the lower classes than is the blood of lower classes among representative upper class people. There are plenty of exceptions, and the introduction of the blood of the more able or attractive of the lower class into that of their superiors in position has undoubtedly been of greater value than the reverse condition, for a descent in the social scale usually indicates loss of some of those traits which enable one group of people to maintain their superiority over another group.

NUMBERING THE ANCESTORS

Having noted the ancestors as far as known, in the fashion described above, the next step is to number each one. Begin with the person whose ancestry is to be traced, let his father be No. 2, his mother No. 3, the paternal grandfather No. 4, the paternal grandmother No. 5, and so on, numbering down to the foot of each column, and giving a number to any blank just as if the names were recorded. Thus each male has an even number, and each female an uneven number.

Take a sheet of paper, the same size as the charts, and head it with the name and number of an individual. On this sheet in proper order write all the information known about that person. Give his life history. Describe his physical and mental characteristics. On the reverse of the sheet give a list of his children (in the case of women, the names of children by another husband than the ancestor should be given, but do not duplicate the names of children on her husband's sheet). Number the children, the eldest being No. 1, and record the dates and places of their birth, marriage and death, and the places where they lived; their occupation or profession, and what is known of them, their mental and physical characteristics, accomplishments, and whatever is of interest in them or their descendants. If necessary, add sheets bearing the same number, and lettered in order, as No. 1A, No. 1B, etc.

It will be seen that from such a record, however incomplete it may be, can be discovered very much of interest and value. The reading of C. B. Davenport's book "Heredity in Relation to Eugenics,"[2] or M. F. Guyer's "Being Well Born," will serve to direct one as to the character and detail of the information which should be preserved, and the use that information can be put to. Other information which should be recorded is whatever pertains to the military, naval, civil, educational, or social activities of the person described.

Every item recorded should be accompanied with a reference to the source of information. This is most important. Enclose the reference in parentheses after the statement, thus "Born 10th Oct., 1836 (Family bible in possession of Aunt Mary Smith)," "Served in Jackson's 10th N. H. regiment, Clay's company, June, 1862–Sept., 1864 (Regimental History by Jones, page 345) (also enlistment and discharge papers, my possession)." "Black hair and eyes, tall (5 ft. 11 inches), weight about 190 pounds (statement of Chas. F., his son)." "Died Jan. 20, 1897 (gravestone at Lebanon, also Lebanon town record)."

As it is not likely that the information to be entered on these sheets will be at hand, it is well to consider how it may be obtained.

THE FIRST STEP

The first recourse one thinks of is some relative more or less acquainted with the family history. Sometimes a personal interview is practicable, but it

[2] Even more useful is *Bulletin No.* 13 of the Eugenics Record Office: "How to Make a Eugenical Family Study," by Charles B. Davenport and Harry H. Laughlin.—THE EDITOR

is rarely that the first interview yields all that the person interviewed really knows. If a letter is written, it is best not to demand too much information at first. Proceed by degrees. Everyone may not be as interested as you are, and to write at one time a detailed history of all the members of the family of whom one has knowledge is a task apt to be shirked rather than accomplished. In the first letters ask only the leading questions. Let each subsequent letter deal with a special individual or subject. File the answers to your letters of inquiry, giving each a proper number, if practicable the number of the person to which it mostly relates.

The second step is to discover if there exists any family record, as is often found in a Bible, and to cover every item therein. Great care should be taken in writing such abbreviations as Jan. and Jun., and in writing dates. A careless copy often leads to much vexation at a later period when the original cannot be referred to.

If members of the family have been interred in some nearby cemetery, their gravestones should be examined to obtain the dates usually cut upon them.

If the family has resided long in one place, the town record of births, marriages, and deaths will yield information. So, usually, will the church records, especially of certain denominations. Admissions and dismissals from church membership should be examined as well as records of baptisms, marriages and burials. The latter are not always kept.

The above sources of information having been exhausted, one may now seek information in printed books. To discover if any family history has been published examine the list of American and English Genealogies published in 1910 by the Library of Congress, which may be had of the Government Printing Office for a dollar, if it is not on the shelves of the local library.

If the local library has ever paid any attention to genealogy, it will most likely have Durrie's Index, and later publications, giving lists of articles devoted to certain families which may have been printed. A well-equipped library will have a number of reference works of that character, and may possess the Index to the first fifty volumes of the New England Historical Genealogical Register, a valuable and expensive work which will prove of the greatest service, especially if the family lines run back to New England.

For New York, and many New England families, the New York Biographical Genealogical Record will be found useful, and for the South such publications as the *William and Mary Historical Quarterly* and *The Virginia Magazine of History and Biography*. There are a number of genealogical periodicals, published privately or by societies, and proceedings of historical societies, to all of which the librarian can direct a searcher, or concerning which information may be obtained by writing to *The Genealogical Magazine*, 26 Broad Street, Boston, Mass.

CRITICAL JUDGMENT NECESSARY

In using any printed source it must be borne in mind that all that is in print is not truth. Especially is this true of publications prior to 1880, or even later, as not until quite recent years has genealogy become the exact study it now is, and tradition and guesswork were often responsible for many statements which cannot be authenticated by recorded evidence.

If the family is settled in the West, in fact anywhere west of the Hudson River, it is rare that the family history can be traced for more than three or four generations without resorting to the original records found in the older settlements.

It may be that histories of the family under investigation have been printed either separately or in some town or county history. Such publications are very numerous for some portions of the country, and are more or less helpful according to circumstances.

A few libraries have sought to place all such publications on their shelves. Every library should have some guide to what has been published. Inquiry and a little persistence will sometimes result in the purchase by local libraries of a few of the most useful books. Libraries rarely buy what there is little or no call for, and the average library

appropriation is far too small for its needs.

One of the most important steps is to learn what records exist, and the use which may be made of them. A very useful aid in this connection is a series of articles which appeared in the *Genealogical Quarterly Magazine* for 1900 and 1901. In the July, 1900, issue were published "Some Directions for Compiling and Publishing Family Histories," "The Printed Book," "Eligibility in Hereditary Societies," and "Surnames;" in the October issue, "Some Sources of Information Regarding Pennsylvania and New Jersey Genealogy," and in the December issue, "Records and Record-Searching in England." These articles are all of broader application than the titles indicate, and will be found to abound with references to printed as well as original sources. Other helpful articles of similar nature are found in other issues of that magazine, and its predecessor, ***Putnam's Historical Magazine***. Reference to the "Guide to Contents," under "Genealogy," and similar heads will help. Phillemore's, "How to Write the History of a Family," although intended for English readers, will be found of service, as also Mills' "Foundations of Genealogy." Rye's "Records and Record-Searching," also an English work, may be profitably referred to.

ORIGINAL SOURCES

The original sources may be briefly classified as follows:

Town Records.—In Massachusetts the records of a great many towns have been published in a series entitled "Vital Records," and in addition many other town records have been printed. Every state library has a set of the published Vital Records of Massachusetts.

County Records.—In most states the county seat is the depositary of the probate and land records, and often of marriage records or licenses, as well of other series of helpful records. The settlement of estates is a prolific source of information. The establishment of new counties out of old should always be borne in mind, as the estate of a person dying before the setting up of the new county is found in the old. In some instances there are published lists of estates settled.

State Archives.—The Secretary of State usually has in his charge a great variety of records, relating to grants, lands, estates, soldiers, court proceedings, etc. The Clerks of the Supreme Court have also records of genealogical value. Clerks of all courts are custodians of various records. As a rule only the experienced searcher can use these records to advantage, but they are indispensable in completing a thorough search.

National Archives.[3]—The national government has such an immense accumulation of historical and genealogical material in its possession, that reference must be made to the published guide to the Archives. The most useful series and the series most likely to be used with profit by the beginner in genealogy are the Revolutionary pension files and the Land Office records. The published Census of 1790 is of the greatest value, as most heads of families, their residence, number of males and females in family, and other facts are given. There are also published lists of pensioners at different times. To obtain proof of eligibility to certain hereditary societies these records are of the greatest help. Information regarding any known soldier ancestor who was a pensioner may be had by writing to the Commissioner of Pensions. Most of the older states have published lists of their Revolutionary War soldiers, and there are many lists of soldiers in subsequent wars, while the Civil War rolls of the various states have, of course, been largely published. Application to the Adjutant-General of any state will bring information concerning a Civil War soldier if information sufficient to aid in his identification is furnished.

As one's ancestral record grows, the lack of certain information becomes apparent, and the very character of that information will in itself suggest a course of inquiry if the investigator has taken pains to acquaint himself with the character of modern and earlier records.

[3]This refers to peace time conditions. At present it is not advisable to attempt research in National Archives.

When the time comes that certain definite information is needed, and the source of that information is not accessible, the services of genealogists may be had. There are many persons who follow this profession and are more or less well qualified to conduct a search. Some are merely record agents, that is, they look up certain records and copy the items found. Such agents are usually qualified to suggest further sources of information. Their charges are ordinarily based on the time consumed in the work, so much by the hour or day. Others are what might be termed constructive genealogists. These will accept a commission to work up all that may be found concerning an individual and his ancestry, or a family, and are usually competent to arrive at correct deductions as to relationship, etc. These usually base their charges upon the service rendered, dependent upon the difficulty of the work, its importance, etc. Charges vary greatly. It is always customary to forward the fee in full or part at the time the commission is placed. Of course special arrangements are made in the case of expected extensive and prolonged research.

Having unearthed what may be found about one's American ancestors, it is always satisfactory to learn something of their origin. It is still more satisfactory if their English, Scottish, Irish, French, Dutch, or German ancestry, as the case may be, can be discovered, and this is frequently accomplished. It is a department of genealogical work for which special preparation and experience is needed, and is most successfully undertaken by Americans familiar with European records. The prospectuses so often received by Americans sent out by European record agents, publishers of armorial works, etc., should be carefully scrutinized before acceptance, and if possible information sought of the officers of some of the genealogical societies in this country, who are informed as to the reliability of many of the foreign genealogists.

Foreign investigation sometimes leads to very interesting discoveries. The work of the late Henry F. Waters, the results of which have been largely printed, has given us access to a great mass of material relating to the families of American pioneers of the seventeenth century. Other investigators preceded him and have followed him, and very much is known about our first settlers, far more than is generally realized.

COATS OF ARMS

In all European countries there are certain persons whose right to use armorial bearings is officially recognized. In this country it is a matter of conscience and good form. Coat armor is sometimes the badge of ancient descent, sometimes not. A grant may be of yesterday or of five centuries past. Some arms may be of such antiquity that their origin is unknown. But in every instance the right to arms is hereditary. It is a right which descends usually from the father to all his male descendants. The use of coat armor is hedged about by many rules, and when properly observed these rules are a help in genealogical research. An American who inherited a coat of arms has a perfect right to display that coat, but unless the right to bear arms is undoubted, a matter either subject to proof or of ancient usage, it is considered bad form to use a coat of arms. Arms are not attached to a name, but to a person. All persons of the same name are not entitled to bear the same arms. The usual source of information regarding armorial bearings is Burke's descriptive catalogue of arms made up from every source imaginable. It has no authority whatsoever, and is responsible for more instances of "bogus" arms than any other source. Heraldic Visitations were established in England and maintained for two hundred years, and few instances of legitimate arms escaped registration. Some arms in use prior to the visitations are not recorded. If descent from a person legitimately bearing arms not recorded in the Visitations can be proved, the right to bear those arms exists. Arms illustrated in an American family history are frequently, we may say usually, not authoritative so far as that particular family is concerned. It requires very careful identification to prove the descent of armorial dignities, and the ancestry of

the emigrant has sometimes to be proved several generations to establish any right to arms. In most cases that right cannot be established, whether it exists or not. As the greater portion of the population of any country is not entitled to bear coat armor, it follows that emigrants from such a country are more likely to be of the non-armorial population than the reverse. The average emigrant to America was no more likely to be of armorial dignity than the people of his class whom he left at home. It is true, however, that the emigrant was superior in energy to the people of his class who remained at home. Most of the early emigrants were yeomen, merchants, adventurers, people who were seeking new fields to improve their condition. There was a fair proportion of men of good position who were of the landed class, or men of wealth, or members of gentle families. This proportion was as great in New England as in any part of the country. Moreover, fewer indentured servants were sent to New England, or came to New England of their own accord, than to any other part of the country. Hence if one traces one's ancestry to New England there is perhaps a better chance of discovering the origin of the emigrant than if he went to some other portion of the sea-board.

The emigration of the Scots settled in Ireland (the so-called Scotch-Irish), that of the Dutch to New York, and of the Germans to Pennsylvania and New York, are all special features in genealogical research, and difficulties in tracing American ancestry in the regions in which they settled are somewhat greater than tracing ancestry in other parts. This is due to various factors, such as change in name in the case of the Dutch; and in the case of the Scotch-Irish to the lack of records, both here and in Ireland.

Whether one confines his work to the American ancestors, or follows one or more particular lines across the ocean, the fact remains that without careful work in checking results the conclusions drawn regarding hereditary characteristics will be worthless. The field is a broad one, nor must it be supposed that the characteristics of a remote ancestor are without interest. They are often so vital, so persistent, that a descendant many generations removed appears more nearly allied to some remote ancestor than to those of immediately preceding generations.

The Origin and Evolution of Life

THE ORIGIN AND EVOLUTION OF LIFE, by Henry Fairchild Osborn. Pp. 322, with 135 illustrations; price $3.00. Charles Scribner's Sons, New York, 1917.

Professor Osborn is not satisfied with the current method of studying evolution, because it attempts to reach the causes by working backward from a study of form and function in animals and plants. He proposes to start from the other end and study evolution in terms of energy. The actual problem, he says, is the interrelations of four distinct evolutions of energy: (1) organic environment, (2) organism, (3) heredity-germ, (4) life environment. This is doubtless sound philosophically, but as a method of research it is predestined to failure, for "living energy" is far too elusive a thing for the evolutionist profitably to grapple with. Professor Osborn himself does not get far; he brings together a vast and beautifully illustrated compilation of facts, but the critical genetic reader will quickly discover that the inductions drawn from them present more novelty in phraseology than in ideas. The author admits that much more progress in science must be made before the success of his method can be determined; but certainly those who have used it in the past have found it barren and, indeed, essentially mystical. It is doubtful if even the championship of such a weighty authority as Dr. Osborn will cause many students to revert to the old viewpoint of the "evolution of energy" while the study of form and function is yearly becoming more fruitful.

PETALIZATION IN THE JAPANESE QUINCE

Albert A. Hansen
U. S. Department of Agriculture, Washington, D. C.

EVERY one has frequently wondered just why a cultivated rose should possess an abundance of petals, whereas the wild rose usually has but five petals. To fully understand this phenomenon, fundamental explanations may be of great assistance.

It is well known that a leaf bud is simply a tiny branch bearing a number of tiny leaves; when the miniature branch expands and grows the surrounding bud bracts drop and the leaves enlarge. In such plants as the horse-chestnut the number of leaves contained in the bud is frequently the same as the number of leaves appearing on the resulting developed branch.

In a similar manner there is reason to consider a flower bud as a tiny branch containing leaves, differing in that the stem remains practically the same length throughout the entire life of the flower; *i. e.*, the stem remains shortened instead of elongating, as was the case with the stem in the leaf bud. Upon this much shortened stem are groups of leaves, mostly highly modified; in its fullest expression a typical flower contains leaf groups known as sepals, petals, stamens, and pistils.

The plasticity of these leaf groups is

COMPLETE SERIES FROM PETAL TO ANTHER

A complete series is here represented, starting with a perfect petal to the left. By gradual stages, petals with remnants of the anther lobe attached are reached and next may be noted an anther which has become slightly petaloid, while on the extreme right is the perfect stamen. With the progressive petalization of the filaments, the anther shows less and less development, finally disappearing entirely. (Fig. 5.)

TWO ENTIRE FLOWERS SHOWING PETALIZATION

Views of two flowers of the Japanese Quince, *Cydonia japonica*, showing the extent to which petalization takes place on the individual flowers. Remnants of anthers may be seen on some of the petals, while close scrutiny will reveal slight petalization of some of the anthers. (Fig. 6.)

not ordinarily realized. Complete intergradations may be worked out from the bracts enveloping the flower bud to the whorl of stamens. Thus in the cactus flower it is practically impossible to say where the enveloping bracts stop and the sepals commence. Likewise in the white water lily one cannot distinguish where the sepals stop and petals begin. Similarly, in the flower of the Japanese quince (*Cydonia japonica*), here illustrated, there is a complete intergrading of the petals and stamens, there being no distinct line of demarcation between these two sets of plant structures. An examination of the accompanying illustration will reveal the interesting fact that stamens may be found half of which are in the form of petals, and petals may be seen partly in the form of stamens. The integrading is so complete that entire petals are present containing what appear to be but the remnants of an anther on the top.

A similar phenomenon is exhibited in many double flowers as, for instance, in double roses. By means of cultivation, man has succeeded in changing the stamens and pistils of completely double flowers into petals. That the pistils react similarly is demonstrated in wild plants by certain species of Trillium and in cultivated plants by roses and cherries; in these plants the pistils occasionally are transformed into green leaf-like structures.

In order to create flowers with a large number of petals by means of cultivation, it is obvious then that a plant should be selected for experimentation containing a large number of stamens, a plant such as the wild rose, buttercup, or strawberry. The process is technically termed petalody or petalization. It seems to be aided, as is suggested by the petalization of tulips, by the presence of abundant nutrition, particularly the presence of nitrogenous substances.

Abundant nitrogen in the soil tends toward leaf production among plants in general.

With an appreciation of these facts in mind the question naturally arises: Did stamens originate from petals or did petals originate from stamens? Neither viewpoint can be satisfactorily and adequately supported, although the evidence leans most strongly to the view that petals originated from stamens. This was accomplished probably by the progressive petalization of the filaments, accompanied by a proportionate decrease in development of the anther or zore-sac, until the anther disappeared entirely.

Although scientifically not fully understood, petalization seems to be heritable, since the phenomenon is frequently repeated by the offspring. Inheritance by means of seed is possible when sufficient stamen structure remains for pollination purposes, and inheritance by vegetative reproduction is frequently attained when complete petalization robs the plant of the chance to produce seed. Among flowers of the composite type, represented by the asters and chrysanthemums, doubling never prevents seed production, due to the fact that petalization is of a different morphological nature than the same phenomenon in the groups lower than the composites. Double petunias are propagated by seed in a most interesting manner. The hereditary character of the doubling is so strong that seeds are saved from petunias which are almost completely petalized, only sufficient pistil and stamen structure remaining to insure pollination.

Still another factor which may cause petalization is disease due to the presence of fungi and perhaps to other causes. This type of petalization is not, of course, hereditary, but may be infectious.

The phenomenon of the intergrading of petals and stamens such as is here illustrated is well known, but the fact that it is so perfectly shown in the Japanese quince is not a matter of common knowledge. No mention is made of it in the botanical text-books now in common use in which this interesting subject is discussed, hence the matter is brought to the attention of teachers and others so that a source of unsuspected illustrative material may thus be revealed. Japanese quince is a common ornamental, frequently used in landscape work.

An Introduction to Social Psychology

AN INTRODUCTION TO SOCIAL PSYCHOLOGY, by Charles A. Ellwood, Ph.D., professor of sociology in the University of Missouri. Pp. 343, price $2.00 net. New York, D. Appleton & Co., 1917.

Eugenics is outside the scope of Professor Ellwood's book, and he does not even refer to it directly. But what he has to say about evolution and human nature are of interest to the student of heredity, even though his discussion is largely theoretical and little illustrated by concrete examples. Four widespread views of human nature must now be abandoned, he says. These are (1) the view that the individual is passive and acts only as the result of stimuli from the environment; (2) that the individual's acts are due to the desire to seek pleasure or to avoid pain; (3) that the individual is innately selfish, and such altruism as exists is an out-growth of egoism; (4) that the individual is a self-contained entity. Instead, "science shows the individual to be a self-active unit, fashioned by the forces of an organic evolution which has been, at the same time, a social evolution; that is, the individual has been developed as a member of a group, and the environment to which he has had to adapt himself has been largely an environment of his fellow beings." Action really springs from within, although it is guided by the external environment; and altruism is just as original a tendency in human nature as is selfishness.

COLORS IN VEGETABLE FRUITS

Tomato, Eggplant and Pepper, Belonging to the Same Family, Have Similar Groups of Simple Color Factors—Combinations Are Easy to Make

BYRON D. HALSTED

Botanical Department, New Jersey Experiment Station, New Brunswick, N. J.

THE maturity colors of the fruits of tomato, pepper, eggplant, as well as other vegetable fruits, lend themselves well to a study of their inheritance.

In the tomato fruit, the skin and the flesh may be considered separately at the outset. The skin is either transparent or is colored with an orange pigment. These two types are easily distinguished by removing a portion of the skin, scraping it clean of all adhering pulp and holding it up toward the sun or other light, or laying it upon white paper.

The flesh is either pink-purple or lemon-yellow, and this fact needs no further demonstration than that of making slices through the mature fruit.

It is not claimed that there are no variations, but the above statements hold in a general way and serve as a basis for the more detailed consideration that follows.

As all tomato fruits consist of the interior and the skin surrounding it, and as there are two colors for both flesh and skin, it is clear that the possible combinations are four, namely: (1) lemon flesh and colorless skin, (2) lemon flesh and orange skin, (3) red flesh and colorless skin, and (4) red flesh and orange skin. These four combinations constitute four fruit colors in the order above given as follows: (1) lemon, (2) orange, (3) pink, and (4) red. All of these color-terms are only approximate, but they will serve for the present purpose and have the advantage of being short and leading to no confusion.

In breeding it is found that the pink flesh is dominant over the lemon flesh, and the orange skin is dominant over the colorless skin. It follows that the varieties of lemon-colored tomatoes are doubly recessive, and when bred within the group are not expected to produce any other color of fruit. It, by the way, is a group of kinds that is rarely represented in cultivation excepting where a large assortment is sought for some special purpose. The reason for this general exclusion of the lemon tomatoes is not within the scope of this paper to consider. The orange-colored group of varieties perhaps stands second in representatives in the fields and gardens and is particularly noticeable among the smaller types, like "pear," "plum," and "cherry" sorts used for preserving, pickling, etc. In breeding it is to be borne in mind that the two characters combined are the lemon flesh and the orange skin, in other words a recessive for the former and a dominant for the latter, and within the group the offspring would be expected to be constant in fruit color.

BREEDING TWO GROUPS

Let the two above groups be bred together and it is clear that the flesh will remain the same and the only variation will be in the skin, for here a dominant (orange) is combined with a recessive (colorless), and according to rule in the F_1 all plants will bear orange fruits, and in the F_2 three-fourths of the plants will bear orange fruits and one-fourth lemon fruits. In the third group the fruits are pink (sometimes called purple, as the Ponderosa) and therefore have a dominant flesh color and a recessive skin color. This group seems to stand third on the list for popularity among the growers of the fruit. When bred within its own group, no change need be expected so far as fruit color is concerned. Let it be bred with the first group, the lemon-fruited sorts, and then there is a combination of the flesh colors with no diversity in skin. Here the

result will be according to rule, namely, all plants bearing pink fruits for F_1, and three-fourths of the plants bearing pink, and one-fourth plants bearing lemon colored fruits in the F_2. When bred with the second group, namely, the orange-fruited sorts, the combination is between the colorless skin and pink flesh of one parent with the orange skin and lemon flesh of the other, and therefore both pairs of characters are present. In the F_1 the two dominants assert themselves and all plants produce red fruits, that is, neither parent color is reproduced; while in the F_2 all four of the above named types are obtained in the following ratios: red 9, pink 3, orange 3, lemon 1.

The following table may help to add clearness to the above conclusions by graphically showing the details of the combinations:

is, contain nothing that is unexpressed, and these occupy diagonal squares from the upper left to the lower right hand corner. Plants that arise from these unions, if grown in strict isolation, reproduce themselves and through their progeny for all time either red, pink, orange or lemon fruits as the case may be.

SECOND GENERATION COMBINATIONS

The diagrammatic table is introduced in particular to show in how many ways the four characters are combined in the F_2 of the cross that is here considered. It is seen that the following unions are expected: P. O. 1(2), P. O. c(2), P. O. 1 c(4), P. l. c(2), O. l. c(2); that is, there is one in eight of the plants with red fruits that carries the factor for lemon flesh, and an equal number of red fruited plants with the colorless skin factor recessive. For example, when a

TABLE I

Female \ Male	Red P. O.	Pink P. c.	Orange l. O.	Lemon l. c.
Red P. O.	1 P. O.×P. O. Red	2 P. O.×P. c. Red	3 l. O.×P. O. Red	4 l. c.×P. O. Red
Pink P. c.	5 P. O.×P. c. Red	6 P. c.×P. c. Pink	7 l. O.×P. c. Red	8 l. c.×P. c. Pink
Orange l. O.	9 P. O.×l. O. Red	10 P. c.×l. O. Red	11 l. O.×l. O. Orange	12 l. c.×l. O. Orange
Lemon l. c.	13 P. O.×l. c. Red	14 P. c.×l.c. Pink	15 l. O.×l. c. Orange	16 l. c.×l. c. Lemon

In Table I the upper row shows the possible combinations of the factors as found in the pollen grains, the capital letters standing for dominant factors, while the recessive are represented by small letters. The same set of associated factors for the ovules is shown in the first vertical column on the left. The other sixteen rectangles express the unions that may be made between the pollen grain diagramed above with the ovule given at its extreme left.

Among the sixteen possible combinations there are four that are pure, that

P. O. l. plant is bred to itself or its equal there will result one pure P. O. and one pure P. l. plant to every two of P. O. l. plants and therefore, unless isolation is practiced, there will be a perpetual mixture of red and pink-fruited plants. There is also one plant in every four of the whole block with red fruits that has both recessive characters present, and in the next generation will show all the four sets of combinations that are here being considered. Then there is one in eight of all the plants with pink fruits that is carrying the factor for

lemon flesh and an equal number of orange-fruited plants with the factor for colorless skin unexpressed.

One can only wonder how great becomes the mixing in a field of plants that results after three or more years of breeding together of a red-fruited and a lemon-fruited plant. The segregation into the pure type should be done in the second generation.

The only remaining original type of tomato fruit color to be here considered is the so-called red, and this is the one that embraces the majority of the standard commercial sorts. In breeding, the behavior of this group has been considered in good measure in the scheme that has just been given for the pink-fruited kinds. For example, with the lemon type the F_1 will bring no change, but in F_2 the two pairs of factors have full play, and there results the same set of combinations displayed in Table I.

When the red-fruited plants are bred with the orange-fruited plants there is the absence of the colorless skin, and the only combinations are those of pink flesh with lemon flesh, the skin being orange in both parents and therefore result in a quarter of pure P. O. (red) and half P. O. l. (red) and the remaining one-fourth P. l. (pink). The half will continue to yield pure and also impure red-fruited plants and the pure pink strain.

When the red and pink groups are bred together the flesh is the common character, and therefore the results will conform to that of a monohybrid, as described above for the case when the flesh gave the differing character.

MODIFICATIONS ARE FOUND

As before remarked, this scheme of allelomorphs covers the case of fruit colors in only a general way, because there are seeming exceptions. The colors doubtless are subject to modifications that are likely due to environmental factors. For example, the lemon flesh is not constantly the same tint of pale yellow; in fact there may be much pink mixed with it, so that some commercial varieties bear the name of Blush, alone, or in combination as the Lemon Blush. The pink color seems to be developed by the sunlight and is most evident upon the sun-exposed parts of the fruit. Such strains of fruit are not mistaken for those with solid pink flesh, and rarely show the pink color far below the surface. Similar modifications are met with in the lemon group, and here perhaps are due to the clear skin, the color therefore being actually deeper and the contrasts with the shaded parts of the fruit more pronounced, giving an appearance suggesting the cheek of a peach. The pink group shows differences in the amount of the flesh color that are more or less varietal.

The skin of the tomato plays such an important rôle in determining the color of the fruit that it deserves consideration here. Microscopically the skin consists of the epidermal layer and three or four layers of collenchyma cells, much smaller than those of the underlying tissue and separating from it more or less readily as the housewife appreciates.

Dr. Groth,[1] who has made an exhaustive study of tomato skins, states that "In the colored skins the yellow color resides only in the cuticle and cuticular thickenings . . . However, the skin from any red tomato is at once distinguishable from that of any yellow tomato under the microscope, because the very crystals which lend color to the interior of the fruit also occur in the epidermis and other skin layers. For this reason the skin of red tomatoes always looks a shade darker when scraped and spread on a white back ground, than that of the corresponding yellow forms."

THICKNESS AND HAIRINESS

Dr. Groth found that there is a wide range in the thickness of the skin among the several types, and it is evident that this may account for the many differences in the intensity of the fruit-color, particularly in the kinds with orange skin, and leads to slight variations when kinds of the same color are bred together.

[1] B. H. A. Groth. Structure of Tomato Skins, *Bull. N. J. Experiment Station*, No. 228, Feb., 1910.

He also found that the hairiness of the skin was a very variable character and this tends to modify the color as it appears to the eye.

In this connection the unusual group of "peach" tomatoes is instanced as a special case in which besides hairs the outer surface, instead of being smooth, is papillate, each cell having a convex wall. The outward appearance of the "peach" is quite unusual, due to the reduction of epidermal color-intensity resulting from peculiarity of structure and the hairy coating from which it gets its common name. Furthermore, Dr. Groth found "The scraped skin of the orange-red 'peach' when scraped on white paper, appears lighter than the skin of other orange-red fruits."

Perhaps enough has been given to establish the belief that with tomatoes the subject of color inheritance is one that is not easily and fully settled by any general rule. The color character, as viewed from the standpoint of a critical student of tints and shades, will become somewhat a varietal one, depending upon many factors besides the orange color of the skin and the pink and lemon color of the flesh. The amount of substance colored, whether flesh or skin, will be a modifier; thus a flabby fruit with large air-cavities will be dull as compared with the kind with solid flesh. The smooth skin of the "currant" gives a bright appearance while the "peach" with the same shade of flesh will be dull indeed.

EGGPLANTS

The eggplants of the garden, while in many ways closely related to the tomato, have some additional factors for fruit color. The most common kinds have purple fruits, but among these there are different intensities of this color that may be termed varietal. Thus the Black Beauty is unlike the Dwarf Purple. Furthermore there are two classes as regards the influence of the sun; namely, in one the purple develops under the thick calyx, while in the other it seems confined to the surface that is exteriorally exposed. Furthermore the purple color in the fruit disappears to a large extent, if not totally, as the fruit matures and is replaced by a dull yellow that is comparable with that of the mature tomato or pepper, the latter fruit in particular often showing the purple on the way to the final yellow or red. The opposite to the purple is the absence of color, as illustrated in the various white kinds.

Among those without the purple color are the green fruits when of marketable size. The difference between these green and the white fruits is more than skin deep, that is, they are more or less green throughout the whole flesh of the fruit, while the white ones have little or no green in the flesh when taken mature, but instead are of an ivory-white throughout.

As a basis for calculations in the breeding of the eggplant the following group may be given, founded upon color of flesh and skin; namely, green flesh, white flesh, purple skin, colorless skin. This yields the following combinations: (1) green-purple, (2) white-purple, (3) green-colorless, (4) white-colorless. When the first two are bred together, the F_1 plants will bear only purple fruits with green flesh, but in F_2 a quarter of the plants will produce fruits with white flesh and these, under isolation, will remain constant to these fruit colors, while the green-purple group of plants will contain one-third of pure green-purple and two-thirds that represent the F_1.

When a green-purple kind is bred with a white-colorless sort the two pairs of allelomorphs are represented and there result the combinations that are shown for tomatoes in Table I, with this difference, that only three of the four types are noted at a glance, because the deep purple of the skin obscures that of the flesh beneath. In other words the deep purple fruit may have either white or green flesh, and the decision calls for an examination under the calyx or of the flesh itself.

SOME UNUSUAL SORTS

Aside from the four types above mentioned there are others, as, for example, the striped-fruited group; and this, when bred with a white sort, gives slightly striped fruits in the F_1; and when

united with a purple-fruited kind yields solid purple fruits in the F_1 and a small percentage of striped fruits in the F_2, thus indicating the recessive nature of the character of stripedness. When Long White is bred with Dwarf Purple all the fruits in the F_1 are purple, but in the F_2 four types are secured, namely: (1) purple, (2) pink, (3) green, and (4) white with the ratios of 9 : 3 : 3 : 1. This cross presents a full expression of all four factors that resided in the parents and by isolation, new types, so far as this cross is concerned, may be established; but historically they are probably as old as those from which they sprang in this particular cross.

While red as a final color does not appear in the American eggplants it is common to the genus, as, for example, the Chinese group that breeds with our garden kinds and yields hybrids that are beset with puzzling color combinations.

PEPPERS

Another genus (Capsicum) of the Solanaceae contain the peppers of the vegetable garden. Their fruits are of the same botanical type (berry) as the tomato and eggplant, but usually differ from them in certain structural peculiarities. However, it might be written in passing that the kinship is shown by those members which have fruits so nearly alike in size, shape and color as to be easily mistaken for each other. Thus the tomato pepper closely resembles the dwarf Champion type of tomatoes and from them the fruits of the Chinese eggplant are not easily distinguished at a distance.

The leading colors of peppers are the red and orange, the red being much more common in the market. In breeding, the orange is clearly a recessive to the red.

The skin is transparent and does not develop the combinations noted in tomato and eggplant. There are, however, other color differences that need a word of consideration, and this relates to the color of the fruit before it reaches the red or orange of the fully matured state.

On account of peppers being sold in large part before they are mature, these transitory colors deserve more than a passing word. For example, there are certain leading commercial sorts that are of a light green color while others are dark green. This is due to a lack of much of the chlorophyll that abounds in the wall of the fruit. This character of light green is a recessive to the dark green, as has been shown by breeding together the two types. When mature, these two classes of fruits are not distinguishable by their color.

Again, the color path that the fruit takes in going from the green to the fully mature condition varies. Ordinarily the way is strictly from the green to the red (or orange) by all graduations from green to red (or orange), but there are some kinds that pass first to the orange through an attractive lemon (quite pale at first), and then on to the red. In this last phase the fruits often exhibit, at the same time, a wide range of colors from the original green that may be retained in some parts, due to the lack of exposure to the direct sunlight, to the red and orange mingled with the red. This fleeting maturation color display proves to be a breeding character that is recessive to the ordinary simple line of changes.

WIDESPREAD COLORATION

Lastly, the whole pepper plant may be more or less endowed with the power to develop a purplish color. This manifests itself most frequently in the nodes, but may be so abundant as to mark the green in the whole stem and appear in the petals and the fruit.

This purple color is subject to much fluctuation within the variety, but certain sorts exhibit it generally and often so strongly that the fruit, for example, when green, is so dark that it appears almost black. The breeding values of the purple color are not fully understood. It seems at least to emphasize the relationship to the eggplants where, as previously noted, a similar color abounds and becomes a foundation factor in the grouping of the varieties. In the tomatoes a similar purple, although usually less pronounced, is found

in the stems, and abounds in many allied genera as Datura, etc.

A general breeding color scheme for peppers, not at all inclusive, is as follows: (1) orange-indirect, (2) orange-direct, (3) red-indirect, (4) red-direct. This does not embrace the characters for amount of green in immature fruits; or the presence of purple, that is a general plant color; or those several modifications of red or orange that seem to be associated with firmness of the flesh, that is, a fruit with unusually long vacant spaces is often pale, as compared with the color of the solid fruits.

It is noted that, broadly considered, the tomato, eggplant and pepper have red and yellow as the leading fruit colors. With tomato and eggplant the skin-color is a fundamental character in breeding. In pepper several color factors are active before full maturity, and in this it shows its close affinity to the eggplant. The purple color is a plant character that is most conspicuous in table-mature eggplant, quite common in young peppers and least evident in the tomato, and is subject to a wide range of expression, as influenced by the environment.

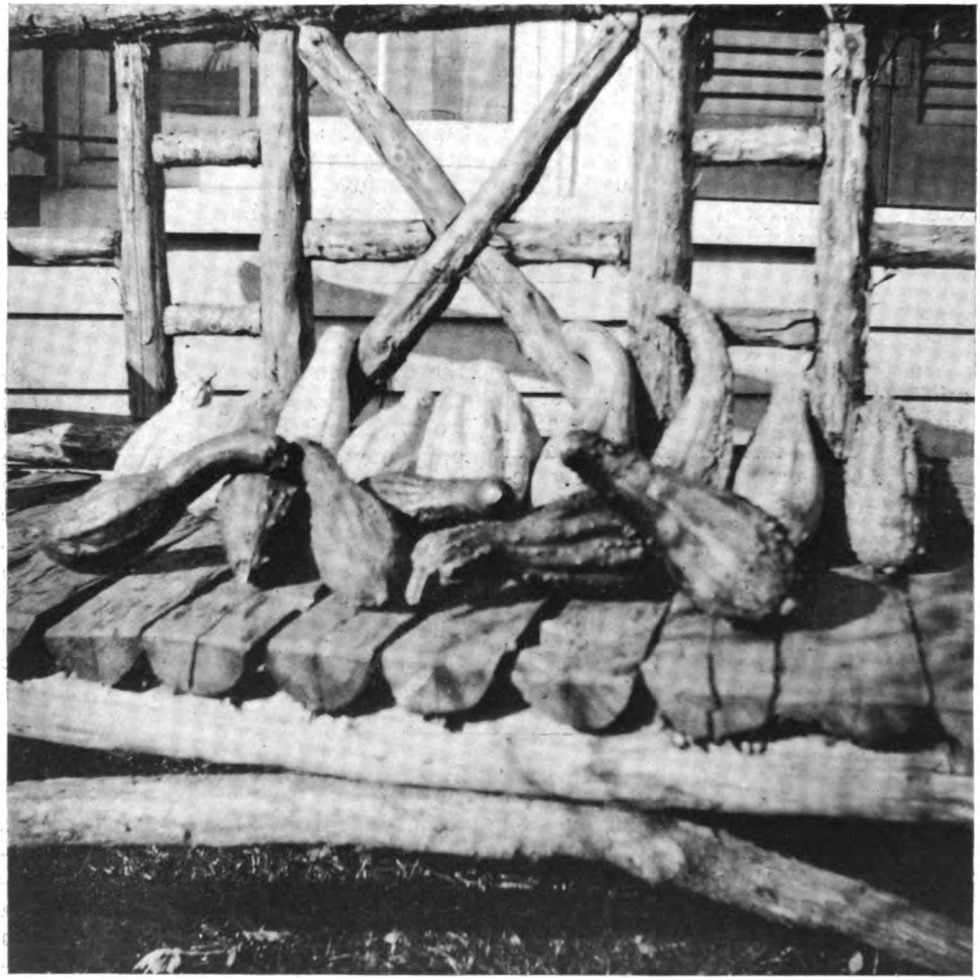
The Cause of Mongolian Imbecility

One of the rarer forms of feeble-mindedness, making up 3% or 4% of all cases, is Mongolian imbecility, so-called because those affected have a facial appearance more or less remotely resembling that of the Mongolian races. Mongolian imbecility has been generally believed to be due to something in the condition of the mother, and not to heredity. Dr. Charles Herrman, writing in the *Archives of Pediatrics* (July, 1917), points to the fact that of twins, one may be a Mongolian imbecile and the other normal. "There is no positive evidence," he concludes, "that worry, emotional shock, illness during pregnancy, or congenital syphilis are important or essential factors in the causation of Mongolian imbecility. The evidence that Mongolian imbecility is a unit character and recessive, although not conclusive, is certainly suggestive." The evidence on which Dr. Herrman relies, however, is very slender, and the case must be considered still open.

Introduction of Insect Pests to be Avoided

While increased production of food stuffs and the practice of war economies is being constantly preached on every side, there is another phase of the problem which is not so generally discussed, but when once considered, is found to be of vast import. This is the prevention of the further introduction of insect pests and plant diseases into this country. The Massachusetts Forestry Association in Bulletin 121 has brought together some striking figures to show the loss annually caused by those pests and diseases which are already present and makes the startling statement that the Bureau of Entomology of the Department of Agriculture has listed over 3,000 more insects which are found in foreign countries as pests and although not yet introduced here may have to be contended with at any moment. It appears that the insects which by a conservative estimate are costing the country $500,000,000 annually are but a scattered vanguard of the myriads which are ready to follow at the first opportunity. Undoubtedly the only possible prophylactic measure is to enact such legislation as will provide for keeping these pests out by keeping diseased importations out. It is not so much a question of keeping the plants out as of how the plants shall be brought in, but without insects and diseases. Effective quarantining *before* the pest has secured a foothold in this country would do much to make the task of those who are producing the food stuffs to win the world war less heavy.

UNUSUAL VARIATION IN CROOK-NECK SQUASH



In the spring of 1916 I planted seed of the "scallop" and of the "crook-neck" squash (without warts), in the same bed. The fruit was the same as the original. I reserved for seed one of the "crook-neck" which I planted this spring. The result was surprising. The forms and general characters were very diverse, as may be seen above, which shows a few of the various shapes. Some were smooth, while others had warts. The colors varied from white and light grey to yellow and orange. (Fig. 7.)

J. GLENN COOK, *Baltimore, Md.*

EVOLUTION BY HYBRIDIZATION

Review of a Book by J. P. Lotsy—Interesting Views Regarding Origin of Variability Set Forth—Extreme Mechanistic Hypothesis Upheld by Author—Analogies Presented Are Interesting but Do Not Constitute Real Scientific Argument

E. C. Jeffrey,

Botanical Laboratories, Harvard College, Cambridge, Mass.

IN THE slender volume which serves as the basis of the present observations, Dr. Lotsy has put forward very interesting views as to the origin of variability. As is well known, Charles Darwin accepted variation as a fundamental and unexplainable quality of living matter, acted upon by natural selection for the production of new species. The great English biologist held that the most significant variations were as a rule small ones, which only became accentuated in the process of time as a result of the cumulative action of the process of selection. More recently De Vries on the botanical side has put forward the view that new species originate full armed, as it were, by the mysterious process of mutation, which takes place in certain instances—for example, in a considerable number of species of the American genus Oenothera, under conditions which have not yet been satisfactorily explained. The author under discussion puts forward the extreme hypothesis that all variability in living beings is due to crossing or hybridization.[1]

Lotsy's attitude is mechanistic in the extreme, as may be inferred from the following italicized statement from his book, the italics being his: "*The problem of the species and its origin is consequently comparable to that of the pure chemical substance and its origin, the problem of the heterozygotes of different constitutions which we find in nature and of their origin is comparable to the problem of the ores found in nature and their origin.*"

It is difficult indeed to see anything in common between a hybrid and an ore (compound) of iron or copper found in nature. This extreme laxity of comparison is all the more surprising, as the author states on a later page (144), "So one reaches all kinds of attractive but quite unfounded conclusions, as *f. i.* (by which the author means for instance), the flapper (*sic!*) of a seal is a metamorphosed hind leg (*sic!*) of a land animal, which conclusion is about as well founded as that the door of my house is a metamorphosis (*sic!*) of the door of my neighbor's (*sic!*)." Quite aside from any obvious criticism of the author's English, he clearly labors under the elementary error of supposing that the flipper of a seal represents the posterior appendage of a land mammal, and he further supposes that evolutionists still hold to the antiquated doctrine of metamorphosis.

Charles Darwin with characteristic honesty admitted his indebtedness to Paley's "Evidences of Christianity," which he was forced to study in college, in acquiring a clear and logical method of reasoning. It would apparently be well for the mechanistic biologists, who swarm at the present time, to admit also their indebtedness to the oldest if not the least dogmatic of the sciences, theology. If they had the grace to do so, their debt would doubtless be to Bishop Butler's famous "Analogy of Religion." Lotsy's comparison of hybrids with metal ores is on all fours with the well-known Butlerian argument that the human worm will enjoy a future winged state because the lowly caterpillar later becomes the resplendent

[1] *Evolution by Means of Hybridization*, by J. P. Lotsy. The Hague, Martinus Nijhoff, 1916.

butterfly. Analogies are interesting but they do not constitute scientific argument, however much they may appeal to the socialistic and half educated mind. Much of the present-day mechanism has a foundation not more substantial than the resemblance between a butterfly and an angel.

NATURE OF SPECIES

Our author makes a serious beginning with his subject in connection with the discussion of the perennial subject of the nature of a species. He points out that the Linnean conception of a species was a collection of like individuals, influenced more or less in unimportant details by conditions of environment. For some reason, which he does not make clear, he also conceives this to be the morphological definition of a species. An unfortunate defect of the work throughout is a strong bias against morphology, which Darwin strongly states in his "Origin of Species" to be the soul of biology. To the Linnean definition of a species the author applies the name Linneon. Jordan in the nineteenth century pointed out, in a controversy with De Candolle, that it was necessary that a species should not only be defined as an aggregation of like individuals, but that there should be added to this conception the quality of coming true to seed. To this conception the author applies the name of Jordanon. His own conception of a species is an assemblage of like individuals, which not only breed true to seed but likewise show themselves genetically pure when back-crossed. He naively admits, however, that this definition does not work in every case and that the morphological criterion of pollen sterility must be employed in doubtful instances. Following Lotsy's own terminology the genetically determined species may perhaps be designated a Mendelon. It seems clear that genetical analysis, in addition to the older criteria of Linnaeus and Jordan, cannot be considered as infallible criteria of species, however much the tendencies of the moment may seem to justify such a conclusion. There are many cases of known hybrids which are quite constant under the most severe genetical analysis. If a definition of a species is something really attainable, it must be arrived at by the use of all possible data, and above all those supplied by internal morphology. To the conception of a species thus broadly founded, we may perhaps, in harmony with Lotsy's terminology, apply the designation, Darwinon, after the greatest of all biologists.

Perhaps the most suggestive chapter in the work is that which deals with the possibility of Linneons, or assemblages of like individuals, taking their origin from self-fertilized hybrids on the one hand, or from a hybrid community in which free intercrossing obtains on the other. In the former instance heterozygosis in a few generations is reduced to an extremely small percentage, on the basis of *formulae* put forward by Jennings. In the case of the free intercrossing of heterozygotes, dominance and partial dominance in a short time make for an apparent uniformity which would well accord with the ordinary systematic conception of a species, that is the Linneon as defined by our author. It is perhaps well to point out in the present connection the interesting results obtained by Professor Tower of the University of Chicago in his interbreeding in nature of two species of potato beetle, namely the Colorado beetle, *D. decimlineata*, and the Mexican, *D. oblongata*. A uniform community was obtained in a few generations, which quite accords with the theoretical conclusions reached by Reimers, and cited by Lotsy in the case of the freely crossing heterozygous population.

A FUNDAMENTAL DEFECT

The fundamental defect in the work under review seems to be an excessive confidence in experimental results. Its author assumes that, since variability in offspring is a well-known consequence of crossing, hence all variability is an indication of heterozygosis. This will be admitted by all but jug-handled geneticists to be a conclusion without solid foundation. The morphological criteria of hybrids, geographical distribution, and development in geological time should all be taken into consideration in arriving at conclusions

which are likely to have any permanent value. A significant fault in our author is a depreciation of morphology and phylogeny, although he admits his former close relations with these aspects of biological science. When a man past middle age abandons the beliefs of his most vigorous years, the critical reader is not likely to have much more confidence in his later than his earlier faith.

As a matter of fact, however, our author's biological faith can never have been very well founded, for he makes the sweeping statement that all groups at their period of greatest luxuriance are in a condition of hybridism and in their later and degenerate stage represent a few purified and homozygotic species, which show a repugnance to crossing. He cites the cryptogamic groups in proof of his assertion. The living Equiseta or horsetails were represented in the past by numerous and arboreal Calamites, which are assumed by the author, quite without proof, to have been heterozygotic. The only possible evidence in this connection is morphological since the genetical analysis to which our author strongly inclines is quite unavailable in the case of extinct plants. The spores of all known Calamites are uniformly well developed and do not show the imperfections characteristic of hybrids. There is good reason, then, for regarding the ancient and more luxuriant representatives of the horsetail stock as quite homozygous. In the case of the living survivors, however, the case is quite otherwise. Here there are very numerous varieties as well as recognized species. One of the systematically admitted species, *Equisetum littorale* Kuel, on the basis of its anatomy and highly abortive spores is a cross between *E. arvense* L. and *E. fluviatile* L. Miss Holden has shown that *E. variegatum* var. *Jesupi* is highly sterile and on anatomical gounds a cross between *E. hiemale* L. and *E. variegatum* Schleich. Investigations proceeding in the reviewer's laboratory tend to show that a number of the so-called varieties of the species of Equisetum are in reality nothing but hybrid forms. Thus in the horsetail stock the older forms contrary to Lotsy's assumption are probably homozygous in spite of their numbers and vigor, while the few surviving species of the stock are characterized by a large amount of hybrid contamination. A similar case could be readily made out for the fern stock.

CONDITIONS FOR HYBRIDIZATION

As a matter of fact hybridization cannot occur unless conditions are favorable. The lower vascular plants which owe their fertilization to the agency of male elements swimming in water cannot freely cross if they happen to live on land. The crossing of existing species of the genus Equisetum is apparently favored by the appendages attached to the spores, which cause them to adhere in clusters while in the dry condition. Later, when germination takes place, cross fertilization is favored by propinquity. The Calamites and their Mesozoic successors had no such appendages to their spores. Among the cryptogams crossing can only occasionally occur, and this situation still obtains to a large extent in wind pollinated forms, such as the Conifers. What Lotsy elucidates as favoring his hypothesis that earlier groups in their plastic and luxuriant phase freely hybridize in reality bears quite another interpretation in the light of actual history. The older forms possessed a number of clearly recognized characteristics, which made them unsuited to modern conditions. Just why these features unfitted them for actual existence we do not know, but it is abundantly clear in all the great lines of vascular plants that those of old time had an archaic organization, which in every case was correlated with relative extinction under modern conditions. This is a sufficient reason on inductive grounds, however defective it may be from the purely imaginative, for their having passed from the scene. Hybridism seems to have had little or nothing to do with the matter, to judge from the actual facts. To take a parallel case, ancient languages were to a large extent written from right to left, as for example the early Latin, the most ancient Greek of the age preceding Solon, the hieroglyphics of the Egyptian monuments, etc., and even many of the older

runic inscriptions of our own Teutonic stock. Languages of this type have actually ceased to exist (except in the Orient) or have modified to the modern style of writing from left to right. This linguistic situation can as readily be explained by resort to heterozygosis as can that of the disappearance of the ancient arboreal types of fern-like plants which flourished so luxuriantly in the coal forests of the Paleozoic.

The case of the Angiosperms stands by itself, and unfortunately it is this very group upon which the greater part of the genetical theories of the day have their sole support. As our author points out, insect pollination and the capacity for cross fertilization are a striking feature of the highest seed plants. This has led to wholesale hybridization, the wide extent of which we are only beginning to appreciate. It has been stated that there are scarcely any pure blooded species among the Rosaceae. Recent investigations from the anatomical and reproductive side have made it clear that great numbers of the recognized species of the large genus of pondweeds (*Potamogeton*) are in reality hybrids. So accomplished a systematist as Professor Trelease has recently listed more hybrid oaks than recognized species among our splendidly abundant American *Querci*. It is becoming obvious to all but a very few that the genus *Oenothera* is a plexus of hybrids and not an aggregation of even reasonably pure blooded species.

HAS STIMULATING EFFECT

Dr. Lotsy's book will be accepted rather for its stimulating effect than for the accuracy or sufficiency of the facts that it brings to bear. It is now quite clear that hybridization has played a very large part in the evolutionary history of the highest and most useful plants, the Angiosperms; but mechanistic and exclusively genetical methods of attack are quite inadequate to resolve the fascinating and complicated problems thus opened. Mendelian analysis alone, and experimental methods by themselves, can lead to no reliable conclusions. The geneticists will be compelled to renew their acquaintance with morphology, else, in the words of Mr. Kipling, it will be said of them:

"They steam for steaming's sake
Their port is all to make."

The Influence of Heredity in Diabetes

"A Study of the Significance of Heredity and Infection in Diabetes Mellitus" is reported by Dr. John R. Williams, of Rochester, N. Y., in the September issue of the *American Journal of the Medical Sciences*. He presents 100 case-histories of diabetics and an equal number of non-diabetics, careful inquiry having been made about the relatives in all cases. He finds that "diabetes, arterial disease, and obesity occur with extraordinary frequency in the parents and ancestors of diabetics, and also that they appear commonly in their progeny." Dr. Williams takes pains to point out that facts of this sort are not crucial enough to be offered as proof that diabetes is inherited; "they do justify the conclusion, however, that a favorable soil for the disease is created in the offspring of those afflicted either with diabetes or arteriosclerosis, or with both combined; and to a lesser degree with obesity."

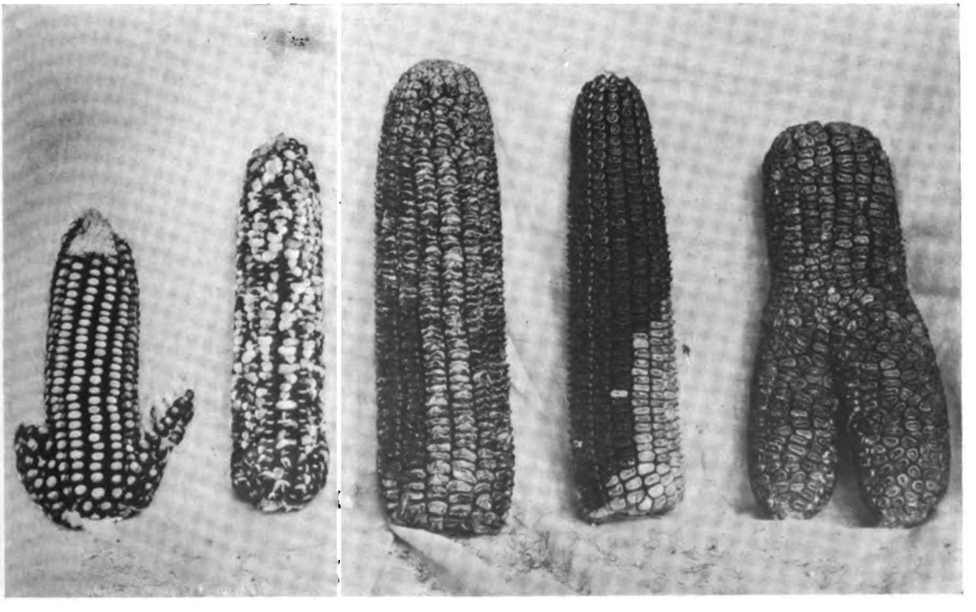
SOME VARIABLE EARS OF DENT CORN

A. D. SHAMEL, *Riverside, Cal.*

EVERY autumn many corn growers find odd and peculiar ears in their crop. The explanation for these variations from the normal is not always clear. Some of them, however, such as those due to Xenia, have received the attention of scientists and the cause of this condition has been satisfactorily explained. The accompanying photographs of some typical freak ears of corn were collected by the writer and are shown as illustrations of some interesting cases of variations of corn ears coming under his observation. The ears in Figs. 8 and 9 were collected from two crops of yellow dent, and those in Fig. 10 from a crop of white dent corn. The monstrosity shown in Fig. 11 was found in a field of Reid's yellow dent.

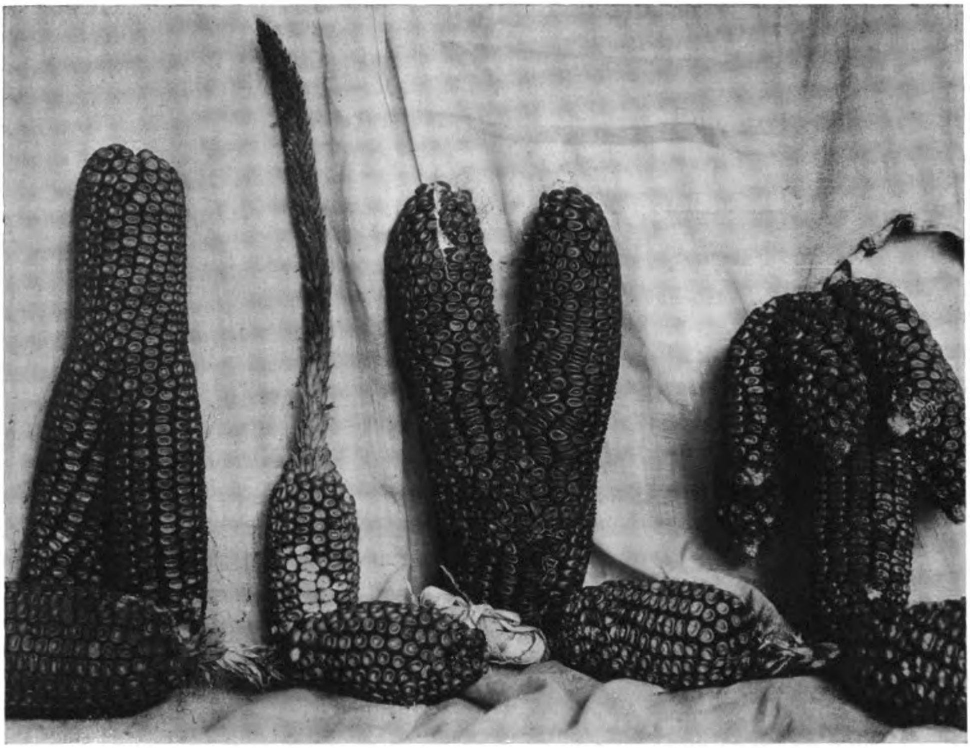
It seems desirable, from the viewpoint of the writer, that corn growers be urged to look for variable ears of corn, particularly those showing strikingly different characteristics from those of the variety grown. These variations or sports are not likely to be of much importance or value from the standpoint of securing valuable seed, but they are likely to be of interest and importance to students of the principles of variation and breeding.

The writer feels strongly the desirability of this effort to secure further information concerning the variability of corn varieties from the fact that he remembers finding many interesting cases of variability which at the time were not thought to be of sufficient value and importance to photograph or



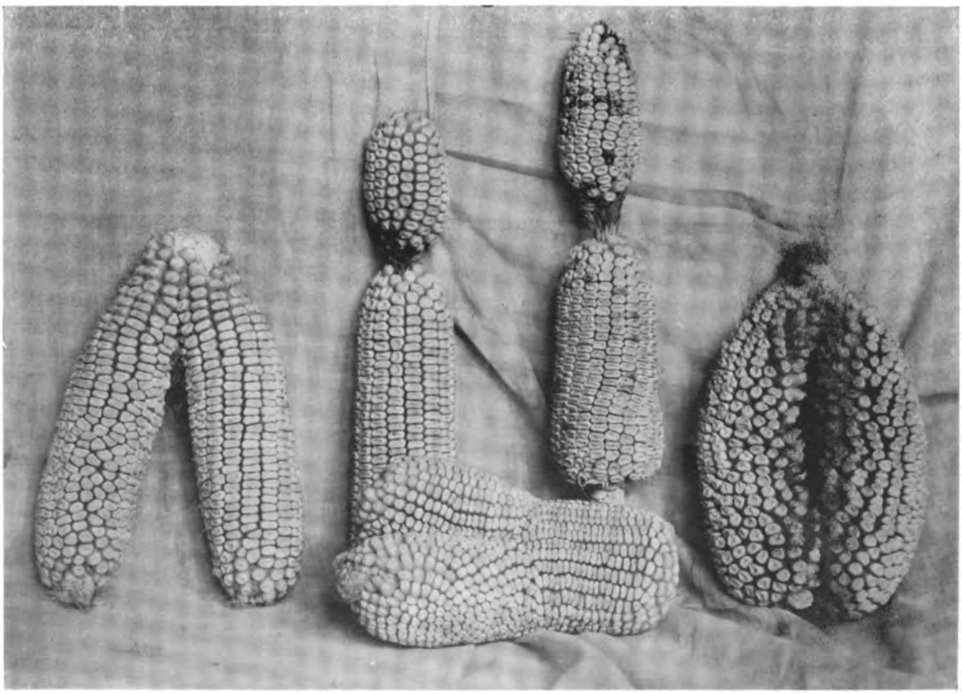
INTERESTING VARIATIONS OF YELLOW DENT CORN

While explanations have been offered as to the causes of some of these variations, the reason for others remains a mystery. A study of similar variations and their behavior during propagation has done much to throw light upon the origin of our corn varieties and has assisted in the formulation of fundamental principles of breeding. (Fig. 8.)



SOME FREAK EARS OR SPORTS OF YELLOW DENT

The development of the pistillate and staminate inflorescene is well illustrated in three of the ears shown in this illustration. (Fig. 9.)



SPORTS FOUND IN A FIELD OF WHITE DENT CORN

In the case of two of these ears staminate flowers occurred with the pistillate as can be seen in the photograph. Such variations as these are not only striking at first sight, but offer a great field for extended study. (Fig. 10.)

AN UNUSUAL CONVOLUTED EAR STALK

A striking freak or sport found in a field of Reid's yellow dent corn. The extraordinary development of the ear stalk, the unusual occurrence of twin ears, and the peculiar leaf growth makes this case one of the out-of-the-ordinary illustrations of corn variations. (Fig. 11.)

describe. It seems likely that if a more general interest is aroused in the importance of this matter that some valuable information can be secured from constantly occurring variations in corn which will be of scientific interest and possibly of practical value in the study of the improvement of corn varieties through seed selection and breeding.

It seems to the writer that observers should be urged, upon finding interesting cases of corn varietions, to send them to the State University, or to the Federal Department of Agriculture, or to other institutions where the subject of plant breeding is being investigated. This effort, the writer believes, will tend to increase the interest of corn growers or others in a more careful observation of the corn crops, and this more intense observation may also lead to a better and more careful selection of valuable seed ears for propagation than is ordinarily the case.

Organic Evolution from a Paleontologist's Point of View

ORGANIC EVOLUTION, by Richard Swann Lull, Ph.D., professor of vertebrate paleontology in Yale University. Pp. 729, with 253 text figures and 30 plates; price $3.00. The Macmillan Co., 66 Fifth avenue, New York City, 1917.

Professor Lull's very comprehensive work will be welcomed by students of evolution who want in accessible form the facts in the family history of animals. Whether it be an elephant or an insect, the ancestry can here be learned with a minimum of search, and all geneticists owe the author a vote of thanks for his critical compilation. They will, however, quarrel with him frequently over the more general part of the book, in which variation, heredity, and the methods of evolution are described. This has a peculiarly antiquated air, suggesting the biological literature of a generation ago, and shows little knowledge of the modern work in heredity which, as many students think, has thrown more light on evolution in 20 years than the preceeding half century had given. It would not be fair to condemn Dr. Lull too severely for the inadequacy of his biological discussion, for he writes primarily as a paleontologist. But at least it is necessary that those who read the book—and they will be many—should be on their guard. Apart from this, the book can be warmly commended and will probably not fail to gain the wide circulation it deserves.

Alcohol as a "Racial Poison"

It is widely supposed that alcohol is a "racial poison," that is, that it can so affect the germ-plasm of an individual as to originate defect or degeneracy in the individual's offspring. But the evidence is contradictory. The widely-known experiments of Charles R. Stockard (see Journal of Heredity, Vol. V, p. 58) indicate that it affected the progeny of guinea-pigs; but Raymond Pearl found no marked evidence of defects in the offspring of alcoholized fowls; nor is there any adequate proof that alcohol produces defects in the offspring of the man who drinks it. L. B. Nice reported in 1911 that white mice were not markedly affected when alcohol was given in their food; but in the light of Dr. Stockard's experiments he determined to repeat his own, administering the narcotic by inhalation instead of in the food. The results are described in the *American Naturalist*, Oct., 1917. The study is small in extent but so far as it goes does not show any serious effect of alcohol either on fertility, vigor of growth, or viability. Professor Nice points out• that guinea-pigs are particularly sensitive animals, and that it is a mistake to draw conclusions from them and apply them too sweepingly to other species.

COLOR INHERITANCE IN MAMMALS

VIII, Swine—Much Evidence Still Necessary to Clear up Problems—Three Independent Kinds of Variations Can Be Distinguished

SEWALL WRIGHT

Bureau of Animal Industry, Washington, D. C.

THE published data on color inheritance in hogs are rather fragmentary, and few certain conclusions can be drawn. There are, nevertheless, some features of very great interest. There is considerable variety of color. Self colored black, red, and white breeds are known. All three kinds of bi-colors, and also tri-colors, are familiar. The color of the wild *Sus scrofa* is none of these but a pattern something like the agouti of rodents. In the young there is a yellowish ground color, with dark, longitudinal stripes. The dark color increases later at the expense of the yellow, producing a sort of agouti pattern.

WHITE PATTERNS

There are several kinds of white patterns. One of these is the belt of Hampshire swine which bears a resemblance to the pattern of Dutch belted cattle, Dutch rabbits and, to a less extent, to that of other piebald mammals. In Hampshires the ground color is black. Simpson[1] has shown that the belt can be transferred to red hogs by crossing Hampshire with the red Tamworths or Durocs and extracting reds in later generations. In this way he has developed a belted red breed. It is clear that, whatever its mode of inheritance, the factor or factors for Hampshire belt belong in class $1a_2$, as determining a white which replaces color irrespective of its quality and producing a piebald pattern.

The mode of inheritance has not yet been thoroughly cleared up. The pattern varies from white merely on the fore feet, through the clear-cut pattern of the Hampshire in which the belt passes from the forefeet over the shoulders to a condition found in German Hanoverian swine in which only the head remains colored. There is in most cases a tendency to dominance in F_1. Thus in the cross of Hanoverian by the self-colored European wild boar, the hybrids are belted though less than in Hanoverians.[2] Segregation of a unit factor, however, is not certain. Even in pure Hampshires, Spillman[3] found that

SOLID BLACK HOG—vdE_H

$1a_1$	—	
$1a_2$	V, v	V = white belt of Hampshire. Unit factor not certain.
$1a_3$	—	
1b	D, d	E_YD = white to roan, E_Yd = sandy to red.
$2a_1$	—	Agouti of wild vs black of Hampshire?
$2a_2$	E_Y, E_B, E_H	E_B = black spots on red ground (carried by selection nearly to solid black in Berkshires and Poland Chinas, to solid red in Duroc-Jersey and Tamworth. E_Y = solid red (present associated with D in solid white Yorkshires and Chesters) E_Y, E_B and E_H have not been proved to be triple allelomorphs. Two independent sets of factors may be involved.
$2a_3$	—	Black of Hampshire vs Agouti of wild? (See $2a_1$).
2b	—	

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

[1] Simpson, Q. I. 1914. JOUR. HER., 5:329-339.
[2] Fröhlich, G. 1913. *Jour. f. Landw.*, 61:217.
[3] Spillman, W. J. 1907. *Sci.*, 25:541.

the inheritance could not be explained short of two factors, as belt by belt might produce solid black, and self by self might produce belt. No doubt part of the variation is developmental, and not genetic, as has been suggested by Simpson.[4]

Another type of white pattern is found in the irregular splashes formerly common on the sides of Poland-China, and Berkshires. In a reduced form, this type of white seems to be responsible for the six white points on feet, nose and tail of the present representatives of the above breeds. A third type of white is found in the solid white breeds, as the Chesters, Yorkshires and German Edelschwein. The white in red roan Tamworth-Yorkshire crosses, and in blue roan Sapphires, are additional kinds.

THE WHITE OF YORKSHIRES

The relations between the solid white of Yorkshires and the black with white points of Berkshires and Poland-Chinas has been worked out by W. W. Smith.[5] In his crosses, F_1 was always solid white. A Berkshire backcross gave thirty-two white to thirty-three black, the latter with more or less extensive irregular splotching with white. A Poland-China backcross gave nine white to twelve black, the whites in this case showing small spots of black in most cases while the blacks were splotched with white as in the Berkshire cross. F_2 from the Berkshire cross gave twenty pure white to six splotched black. The evidence is clear for a unit Mendelian difference which determines a big difference in level in a series from clear white through white with black spots, to black with white splotches. It is also clear that there are independent subsidiary factors favoring white in the Yorkshire and black in the Berkshires and Poland-Chinas. One point of great importance is the failure of red spots to appear in F_2 or the backcrosses. There is no evidence that Yorkshires transmit anything which tends to change black to red and, indeed, the occasional small spots which may appear on Yorkshires themselves are black.

When Yorkshire is crossed with a solid red as Tamworth or Duroc, F_1 is again pure white. In F_2 and in backcrosses with the red (Spillman,[6] Simpson[7]) there is clear-cut segregation between red and white or nearly white. The latter show more or less red roan. If the writer understands Simpson correctly nothing approaching a solid black ever appears in any generation. Curiously enough in the Duroc cross small spots of black may appear but no red spots. It has been general to consider the white of Yorkshire as a dominant white, which is able to inhibit either red or black, in short a factor of class $1a_1$. The results cited above, however, show great difficulties in the way of this view. As we have just seen, white Yorkshires neither transmit red in crosses with black, nor black in crosses with red. This fact at once distinguishes them from the dominant whites of cattle, horses and other animals. Further, Yorkshire white does not act on color in a way irrespective of its quality. In crosses with black, the white appears to be the extreme in a spotting series. In the cross with red, it appears to be an extreme roan and such spots as may appear are not red but black.

ALTERNATIVE HYPOTHESES

Spillman[8] attempted to account for such results as these on a system of three allelomorphs like the polygamous factors of Wilson in horses and cattle. White is WW, black BB and red RR. This will evidently explain the main genetic facts above, assuming that WB is white with a tendency toward black spotting, and WR white with a tendency toward roan. It does not work so well in more complex crosses, examples of which are cited later. As an alternative hypothesis, it may be supposed that white of Yorkshire differs from red of Tamworth for a reason wholly independent of that

[4] Simpson, Q. I. 1914. *Loc. cit.*
[5] Smith, W. W. 1913. *Amer. Breed. Mag.*, 4:113–123.
[6] Spillman, W. J. 1906. *Sci.*, 24:441.
[7] Simpson, Q. I. and J. P. 1911. *Amer. Breed. Ass. Rep.*, 7:266–275.
[8] Spillman, W. J. 1906. *Loc. cit.*

in which it differs from black of Berkshire. Let us suppose that there is a series between complete extension of black over the coat and restriction of black to the eyes, in which black splotched with red, and red-spotted with black, are intermediates (factors of class $2a_2$) and another series, inherited wholly independently, of grades of dilution of red, a kind of dilution (class 1b) in which black is not appreciably affected. On this view Yorkshire white and the white points of Berkshires are due to extreme dilution of self red and red splotches respectively and cannot be compared with the white of the Hampshires. It should be impossible to transfer the Berkshire or Yorkshire kind of white to a red breed with the production of reds with Berkshire markings or whites with occasional red spots. The white splotching of Berkshire-Yorkshire F_2 hybrids resemble closely in character the red or sandy splotching of Tamworth-Berkshire hybrids and, indeed, purebred Berkshires and Poland-Chinas formerly showed sandy splotching on their sides.

PECULIAR RESULTS

In attempting to apply this hypothesis in detail certain difficulties must be met. Spillman[9] showed that all blacks are not alike in their behavior toward Tamworth or Duroc red. Hampshire by Tamworth produces self black (except for the white belt) while Berkshire or Poland China by Tamworth produces a mixture of black and red like tortoise-shell guinea-pigs. This, however, is not wholly unexpected since Berkshire and Poland Chinas visibly show less perfect extension of black than Hampshires (again overlooking the belt).

A more surprising difference comes out between the behavior of Tamworth or Duroc red and Yorkshire white in crosses with the black breeds. In both of these, black is either absent, or present only in small spots, and one would expect them to contain the same restriction factor for black. Yet where Hampshire by Tamworth produces full extension of black, Hampshire by Yorkshire according to Simpson[10] produces full restriction (white). Similarly, Berkshire by Tamworth produces partial restriction (black-red) while Berkshire by Yorkshire produces full restriction (white). Simpson and Spillman have reported on some very interesting crosses which tend to show clear-cut segregation between some factor in Tamworths and an allelomorph in Yorkshires which produce effects in the extension series. Thus Simpson[11] crossed a pure Hampshire with two roan sows which were ¾ Tamworth, ¼ Yorkshire. The young were 5 black, 4 white, 3 red roan, and 4 red, all with more or less of the Hampshire belt. These may be looked on as 5 fully extended like F_1 Hampshire by Tamworth, and 11 fully restricted (or nearly so), in this respect like F_1 Hampshire by Yorkshire. Spillman[12] reports a somewhat similar cross between Poland-China and Yorkshire-Tamworth hybrids. This cross produced 2 black-and-white (of which one had as much black as a Poland-China) 3 black-and-red, 2 self white (or nearly so) and 2 self red (or nearly so). These may be divided into 5 partly extended like F_1 Poland-China by Tamworth and 4 fully or nearly fully restricted like F_1 Poland-China by Yorkshire.

While these results would hardly be expected *a priori* on the hypothesis of independent extension and dilution series, they are even more difficult to explain on the other theories. If Yorkshire white were simply a dominant white in the usual sense, there is no apparent reason why self reds should appear in either of these crosses. We have seen that Hampshire black is fully dominant over red of Tamworth, that Poland-China black is partially dominant over the latter and finally, that Yorkshire has no tendency to transmit red in crosses with black breeds (Poland-China and Berkshire, at least), yet in the crosses above pure Hampshire or Poland China sires have solid red offspring. On Spillman's hypothesis that black, red and white make up a series of three allelomorphs the results are equally inexplicable. Both crosses must be of

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9 Spillman, W. J. 1907. *Loc. cit.*
10 Simpson, Q. I. 1914. *Loc. cit.*
11 Simpson, Q. I. 1914. *Loc. cit.*
12 Spillman, W. J. 1906. *Loc. cit.*

type BB X RW on this hypothesis, which means that BR must be the formula of both self blacks and self reds in one cross, black-and-reds and self reds in the other, while BW must be the formula of the roans as well as the whites.

It remains to show that these crosses can be explained by the hypothesis of independent extension and intensity series. The necessary assumptions are: first, that there is a unit Mendelian difference between Yorkshire and Tamworth in their reaction toward extended black, the former possessing a dominant, the latter a recessive restriction factor; second, that there is a unit Mendelian difference between the white of Yorkshire (dominant dilution) and the red of Tamworth. The roan York-Tamworth hybrids are thus double heterozygotes. The Hampshires and Poland Chinas transmit more or less extended black which serves to bring out the difference between the two restriction factors, and they also transmit a condition of intensity of red to which white of Yorkshire is dominant. The cross should produce blacks with more or less red, blacks with more or less white, self reds, and self whites in equal numbers. In the Hampshire cross the first two classes become indistinguishable, both being self black. The results are in close agreement with this expectation. The production of solid red offspring from a pure Hampshire or Poland China sire can hardly be explained except as due to combination of a dominant restriction factor from the Yorkshire with the intensity of red of Tamworths. The possibility of producing a red breed dominant even over the black of Hampshires is practically demonstrated.

Thus restriction of Yorkshire and restriction of Tamworth show a segregating difference in their reaction to extended black. It has also been noted that extension of Hampshire and of Berkshire or Poland China show differences which are increased by crosses with a given red. The difference between Berkshire or Poland China and Tamworth or Duroc, on the other hand, tends to be reduced by crosses and there seems to be no good evidence of segregation. Berkshire extension comes out of Yorkshire crosses with almost as much white as black, while Duroc restriction often comes out of Yorkshire crosses with black spots. Thus it is not impossible that Berkshire black and Duroc red may possess the same main factors for extension but have become distinct in appearance through a process of selection of minor factors.

INTENSITY

Turning to intensity, the evidence is clear that white of Yorkshire differs from red of Tamworth by at least one clear-cut dominant factor. There is difficulty, however, in attempting to classify the Berkshires, Poland-Chinas and Hampshires with respect to this series. The fact that the first two ordinarily show only white in place of red, would lead one to classify them with Yorkshire. The failure of reds to appear when these breeds are crossed twice with Yorkshires is further evidence in this direction. On the other hand, Berkshires and Poland-Chinas may show sandy splotches themselves and in crosses with Tamworths or Durocs produce black and red pigs in F_1 in marked contrast with the whites from Yorkshire crosses. Similar results were shown in the more complex crosses cited above.

Some evidence has recently been presented by Severson[13] on crosses between Berkshire and Duroc-Jersey which bears on the genetic relations both as regards intensity of red and extension of black. The offspring of the cross were variable but all intermediate between the parents. Ten were red with varying amounts of black spotting, while two were predominately black, the parts which were not black being white in them. Two sows representing extreme types in F_1, a red with black spots and a blacks with white splotches, were backcrossed with a Berkshire boar. The same kinds of young were produced in both cases. There were reds with black spots, blacks with white splotches, and tricolors. These classes graded

[13] Severson, B. O. 1917. Jour. Her., 8:379–381.

into each other and there was no evidence for segregation of an outstanding unit factor either for extension of black or intensity of red. The indications are that both Berkshires and Durocs possess the same partial extension factor and the same intensity factor. The genetic evidence suggests that both have been selected from a sandy colored hog with black spots. From such a foundation (as far as color is concerned), Durocs (and Tamworths) have been selected for restriction and intensity, so producing solid red breeds, while Berkshires (and Poland-Chinas) have been selected for extension and dilution, so producing black breeds with white points. Selection appears to have worked through minor factors leaving the major factors essentially the same in all four breeds.[14]

In Severson's crosses, extension of black appears to be associated with dilution of red. Whether this is merely accidental or because the paler parts of the coat are the last to be invaded by black or because there is a real physiological interrelation is not clear. Under the last head it is conceivable that competition between the processes of forming black and red pigment might lead to such a correlation.

CONCLUSIONS

The conclusions reached may be summarized in the scheme of factors given below. A system of three allelomorphs in the extension series is adopted for simplicity. There may equally well be two sets of independent factors as far as present evidence goes. The formulae which must be assigned to certain of the breeds, are also given below.

Yorkshires may be assigned minor factors for extension, intermediate in effect between those of Duroc-Jerseys and Berkshires. Black spotted segregates appear in Yorkshire—Duroc crosses in the second generation, while the black spotted segregates from Yorkshire—Berkshire crosses have less black than pure Berkshires. Yorkshires also probably have minor factors for dilution since Yorkshire by Berkshire does not produce red or black-red hogs in F_2. Whether any of the hogs were sandy colored rather than white in F_2 in his crosses is not mentioned by Smith. This would of course be expected on the above hypothesis. Further evidence for the presence of minor factors for dilution may be found in Simpson's[15] cross of Yorkshire with Tamworth. In F_2 he found not only the red of Tamworth and the

	DD, Dd	dd
E_YE_Y	White to roan	Sandy to red
E_YE_B	White to roan	Sandy to red
E_YE_H	White to roan	Sandy to red
E_BE_H	White or roan+black spots	Sandy or red+black spots
E_BE_H	Black	Black
E_HE_H	Black	Black

Yorkshire (white) Chester (white)	E_YE_Y DD vv
Tamworth (red) Duroc Jersey (red)	E_BE_B dd vv+minor factors for intensity of red and restriction of black.
Berkshire (black-white) Poland China (black-white)	E_BE_B dd vv+minor factors for dilution of red and extension of black.
Hampshire (black-white)	E_HE_H dd VV
Essex (black)	E_HE_H dd vv
Wild boar (agouti)	E_HE_H dd vv+Agouti factor or factors.

[14] The following quotations from C. S. Plumb's "Types and Breeds of Farm Animals" are of interest in this connection. "In 1789, Cully wrote: 'They (Berkshires) are in general reddish-brown with black spots upon them'" (p. 472). Youatt is quoted as stating that, about 1830, Berkshires were "sandy or whitish-brown spotted with dark brown or black" (p. 473). Plumb states in regard to Poland-Chinas: "Thirty years ago, large white or sandy markings were common on the body" (p. 490). In regard to Duroc-Jerseys he states: "Eminent authorities think that much of the Duroc-Jersey pig is descended from the sandy-colored Berkshire" (p. 506). Tamworths seem to have been solid red as far back as known.

[15] Simpson, Q. I., 1914. *Loc. cit.*

white of Yorkshire but also light yellowish reds and red roan.

The relation of the wild color to the tame colors is not certain. The wild color may be looked upon, either as corresponding most closely to a yellow like a light Tamworth, modified by the addition of dark pigment, as in sable mice, or to a self black such as an Essex modified by an agouti factor. Simpson[16] seems to incline toward the view that, among the tame colors, the Tamworth red is the closest genetically to the wild type. As pointing the other way, however, may be taken his report of black swine (¾ Berkshire, ¼ Poland-China) with well-defined sandy stripes like the wild. Spillman[17] also speaks of the frequent occurrence of a reddish tinge near the tip of the hair of Berkshires as suggesting the wild pattern. This view—that the wild boar has an extension factor—is also most in line with results in other mammals and is, therefore, perhaps slightly preferable as a provisional hypothesis.

As regards genetic evidence, Spillman[18] records crosses which show clearly a main unit difference with Tamworth as well as lesser differences. The wild pattern was dominant in F_1, while wild and red segregated clearly in a backcross with Tamworth. Reds also appeared in F_2 while some of the dark colored hogs were striped, others unstriped. Probably but not certainly the main difference involved is in the extension series while perhaps an agouti factor from the wild ($2a_1$) or a density factor for black from the tame (class $2a_3$) or both complicate the matter. Fröhlich[19] reports on crosses of a Caucasian wild sow with white Edelschwein, F_1 was pure white and F_2 showed clear segregation into 6 white to 2 black. A cross with a common white boar produced 4 white, 3 gray and white spotted, a result which can be interpreted in several ways. This evidence, on the whole, indicates segregation in the extension series rather than in intensity of red.

One other color is known in the blue roan of the Sapphire, which is being developed by G. C. Griffith. According toMcLean,[20] most of the common breeds were used in the foundation stock. The color seems to have been developed by selection from a white showing a trace of the blue roan. This indicates that the restriction factor is present. If this is true, the blue would be like a sooty yellow genetically, except for dilution of yellow to white.

In concluding this summary, it is clear that color inheritance in hogs is a subject on which much is yet to be done. Nevertheless, the main facts seem to point quite definitely to three independent kinds of variations as responsible for most colors; first, black extension (no black—small black spots—black except for irregular splotches—solid black). Second, variations of intensity which determines whether the ground color shall be white, sandy or red. A third independent kind of variation is clearly present in the white belted swine, in which there is a white which can appear on either a black or red. Further investigation is needed in all three of these groups to determine whether the important variations fall into series of multiple allelomorphs or are due to independent factors.

Sex Ratio in Cattle Cannot Be Controlled

Statistics previously published by the Maine experiment station appeared to indicate that there was some connection between the time when a cow was bred (relative to the beginning of the heat) and the sex of the offspring. A larger series of cases has since been collected, and studied from this point of view. In Bulletin 261 it is noted that "the apparent relation between these two factors, which is believed by many breeders to exist and which our earlier statistics appeared to indicate, seems now to be purely accidental." "There is not now known any method by which the sex ratio or proportion of the sexes in cattle may be effectively controlled by the breeder."

[16] Simpson, Q. I. 1907. *Sci.*, 25:426.
[17] Spillman, W. J. 1907. *Sci.*, 25:313.
[18] Spillman, W. J. 1906. *Loc. cit.*
[19] Fröhlich, G. 1913. *Loc. cit.*
[20] McLean, J. A. 1914. Jour. Her., 5:301–304.

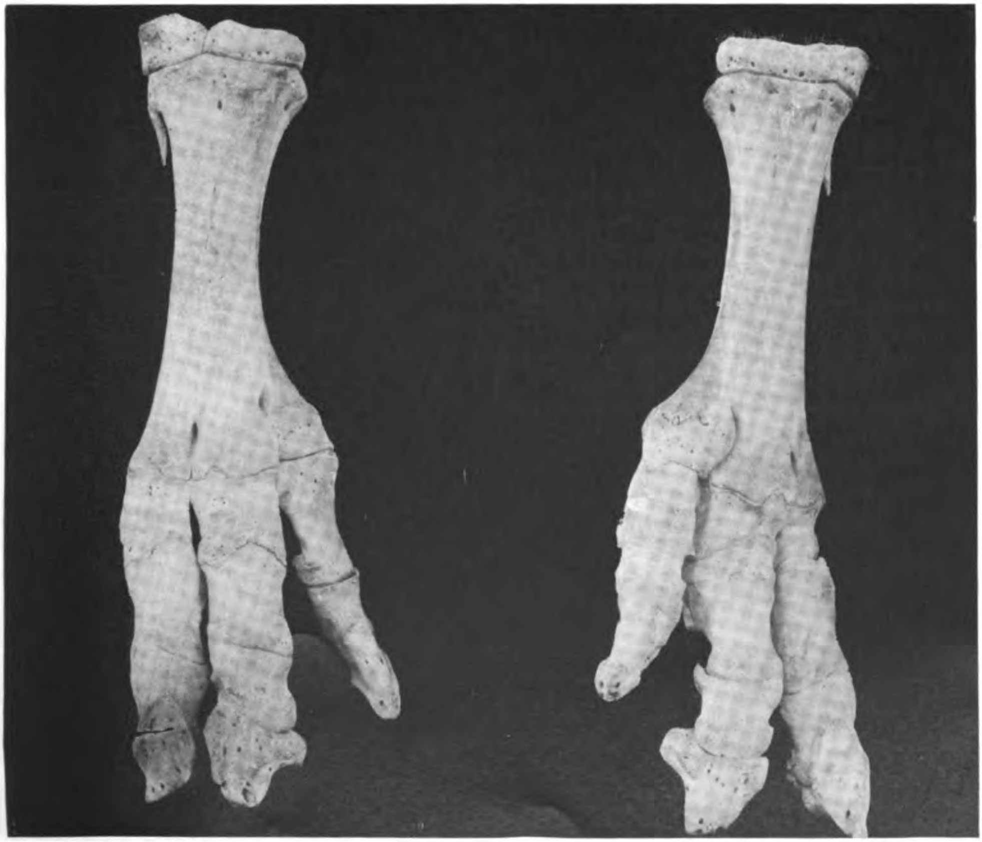
EXTRA TOES IN HORSE AND STEER

B. O. Severson, *State College, Pa.*

DR. MARK FRANCIS, of the Texas Agricultural College and College Experiment Station, has kindly furnished the following photographs of polydactylism in the horse and steer. Fig. 13 is interesting because it illustrates the same bone structure analogous to the case of "Cloven Hoofed Percheron" in a recent issue of the Journal. This is a type of polydactylism which is the result of the splitting of a single digit.

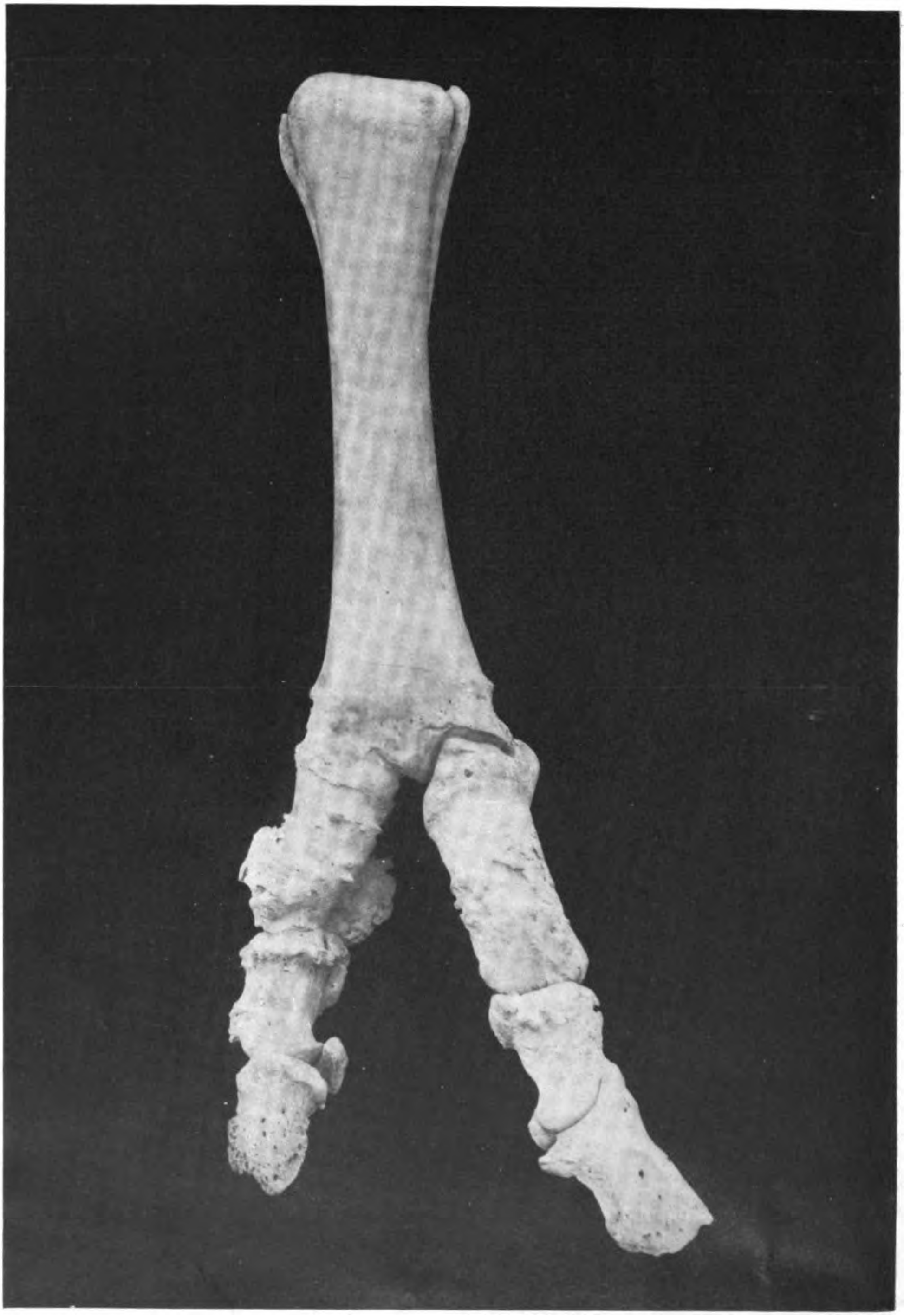
Another type of polydactylism in the horse is illustrated in Fig. 14, namely, reversion to an ancestral form. In this case the extra digit at the pastern joint is connected with the splint bone and is in accordance of results shown by studies on the evolution of the horse. The horse having this variation was normal in the other three legs.

The skeletal bones of the two front feet of a steer are shown in Fig. 12. The bones of three well-developed digits are present instead of two normal digits. The photographs shows very distinctly the continuation of the extra digit from the splint bone. This again is a case of polydactylism of the type known as reversion to the ancestral form.



SKELETAL BONES OF POLYDACTYLIC FEET OF STEER

Where two normal digits should be present, three are found in this instance. The continuation of the extra digit from the splint bone is clearly shown, and makes it apparent that this is also a case of reversion to ancestral form. (Fig. 12.)



AN EXTRA DIGIT CAUSED BY SPLITTING OF BONE

Such cases of polydactylism in the horse as this are caused by the splitting of a single digit producing two digits. It is analogous to the case of the "Cloven Hoofed Percheron" which appeared in the issue of the JOURNAL for October. (Fig. 13.)

A CASE OF REVERSION TO ANCESTRAL FORM

The extra digit is not produced in this case by splitting but is connected at the pastern joint with the splint bone and is probably a reversion to the older polydactylic horse. (Fig. 14.)

A TEST FOR SUPERMEN

Professor Terman's Ingenious Method of Finding How Large a Vocabulary One Commands—Marked Difference Exists Between "Average Adult" and "Superior Adult"

NO SINGLE test can supply an adequate measure of intelligence, but for English-speaking persons the vocabulary test probably has a higher value than any three other tests, says Prof. Lewis M. Terman.[1] In a large majority of cases this test alone will measure the subject's intelligence within 10% of the accuracy of the entire Binet-Simon scale.

The vocabulary used (printed in a box herewith) consists of 100 words "derived by selecting the last word of every sixth column in a dictionary containing approximately 18,000 words, presumably the 18,000 most common words in the language. The test is based on the assumption that 100 words selected according to some arbitrary rule will be a large enough sampling to afford a fairly reliable index of a subject's entire vocabulary. Rather extensive experimentation with this list and others chosen in a similar manner has proved that the assumption is justified. Tests of the same seventy-five individuals with five different vocabulary tests of this type showed that the average difference between two tests of the same person was less than 5%. This means that any one of the five tests used is reliable enough for all practical purposes. It is of no special importance that a given child's vocabulary is 8,000 rather than 7,600; the significance lies in the fact that it is approximately 8,000 and not 4,000, 12,000, or some other widely different number.

"It may seem to the reader almost incredible that so small a sampling of words would give a reliable index of an individual's vocabulary. That it does so is due to the operation of the ordinary laws of chance. It is analagous to predicting the results of an election when only a small porportion of the ballots have been counted. If it is known that a ballot box contains 600 votes, and if when only thirty have been counted it is found that they are divided between two candidates in the proportion of twenty to ten, it is safe to predict[2] that a complete count will give the two candidates approximately 400 and 200 respectively. In 1914 about 1,000,000 votes were cast for governor in California, and when only 10,000 votes had been counted, or a hundredth of all, it was announced and conceded that Governor Johnson had been reelected by about 150,000 plurality. The completed count gave him 188,505 plurality. The error was less than 10% of the total vote."

DIRECTION FOR USE OF TEST

The 100 words thus chosen are arranged approximately (though not exactly) in the order of their difficulty, and the examiner usually begins with the easier words and proceeds to the harder, continuing until the subject examined is no longer able to define the words. "With children under 9 or 10 years," Dr. Terman directs, "begin with the first Apparently normal children of 10 years may safely be credited with the first 10 words without being asked to define them. Apparently normal children of 12 may begin with word 16, and 15-year-olds with word 21. Except with subjects of almost adult intelligence there is no need to give the last ten or fifteen words, as these are almost never correctly defined by school children. A safe rule to follow is to

[1] Terman, Lewis M. (Professor of Education in Stanford University). The Measurement of Intelligence. Boston, Houghton Mifflin Company, 1916.

[2] Provided that the ballots have been shuffled.

continue until eight or ten successive words have been missed and to score the remainder *minus* without giving them."

As to scoring, "credit a response in full if it gives one correct meaning for a word, regardless of whether that meaning is the most common one, and regardless of whether it is the original or a derived meaning. Occasionally half credit may be given, but this should be avoided as far as possible.

"To find the entire vocabulary (of the individual who is being examined), multiply the number of words known by 180. Thus the child who defines twenty words correctly has a vocabulary of 20 × 180 = 3,600 words; fifty correct definitions would mean a vocabulary of 9,000 words, etc. The following are the standards for different years, as determined by the vocabulary reached by 60% to 65% of the subjects of the various mental levels:

	Words	*Vocabulary*
Eight years.....	20	3,600
Ten years......	30	5,400
Twelve years...	40	7,200
Fourteen years..	50	9,000
Average adult...	65	11,700
Superior adult..	75	13,500

Although the form of the definition is significant, it is not taken into consideration in scoring. The test is intended to explore the range of ideas rather than the evolution of thought forms. When it is evident that the child has one fairly correct meaning for a word, he is given full credit for it, however poorly the definition may have been stated.

"While there is naturally some difficulty now and then in deciding whether a given definition is correct, this happens much less frequently than one would expect. In order to get a definite idea of the extent of error due to the individual differences among examiners, we have had the definitions of twenty-five subjects graded independently by ten different persons. The results showed an average difference below three in the number of definitions scored *plus*. Since these subjects attempted on an average about sixty words, the average number of doubtful definitions per subject was below 5% of the number attempted.

"An idea of the degree of leniency to be exercised may be had from the following examples of definitions, which are mostly low grade, but acceptable:

1. *Orange*. "An orange is to eat." "It is yellow and grows on a tree."
2. *Bonfire*. "You burn it outdoors." "You burn some leaves or things." "It's a big fire."
3. *Roar*. "A lion roars." "You holler loud."
4. *Gown*. "To sleep in." "It's a nightie." "It's a nice gown that ladies wear."

The test is particularly interesting since it seems to give reasonably correct measurement of the intelligence of adults, and there are very few single tests which can be easily applied, that give reliable results in such cases. There is, Professor Terman finds, a well-marked difference between the average adult and the superior adult, although the number of words in the vocabulary by which they differ is only ten. A majority of average adults can give sixty-five words, but only one-third of them can give seventy-five words—the test of the superior adult. But of those whom extensive testing shows to be "superior adults," 90% can pass the superior adult test of seventy-five definitions. "Ability to pass the test is relatively independent of the number of years the subject has attended school, our business men showing even a higher percentage of passes than high-school pupils."

While this test may be more reliable than any other single test, it would be a mistake to place too much dependence on it. It is somewhat influenced by the kind of training and education one has had—although less so than would be expected. No single test, and no series of tests, is an adequate measure of the general intelligence. The trained examiner takes account of every clue he can find, and it would be a disservice to psychology to give the impression that any tests are infallible, especially if given by unskilled examiners or by auto-examination. The most that is claimed for the Binet tests, for example, may be stated in Dr. Terman's own words:

"One who knows how to apply the

1. orange	22. outward	42. brunette	61. priceless	81. incrustation
2. bonfire	23. lecture	43. snip	62. swaddle	82. laity
3. roar	24. dungeon	44. apish	63. tolerate	83. selectman
4. gown	25. southern	45. sportive	64. gelatinous	84. sapient
5. tap	26. noticeable	46. hysterics	65. depredation	85. retroactive
6. scorch	27. muzzle	47. Mars	66. promontory	86. achromatic
7. puddle	28. quake	48. repose	67. frustrate	87. ambergris
8. envelope	29. civil	49. shrewd	68. milksop	88. casuistry
9. straw	30. treasury	50. forfeit	69. philanthropy	89. paleology
10. rule	31. reception	51. peculiarity	70. irony	90. perfunctory
11. haste	32. ramble	52. coinage	71. lotus	91. precipitancy
12. afloat	33. skill	53. mosaic	72. drabble	92. theosophy
13. eye-lash	34. misuse	54. bewail	73. harpy	93. piscatorial
14. copper	35. insure	55. disproportionate	74. embody	94. sudorific
15. health	36. stave		75. infuse	95. parterre
16. curse	37. regard	56. dilapidated	76. flaunt	96. homunculus
17. guitar	38. nerve	57. charter	77. declivity	97. cameo
18. mellow	39. crunch	58. conscientious	78. fen	98. shagreen
19. pork	40. juggler	59. avarice	79. ochre	99. limpet
20. impolite	41. majesty	60. artless	80. exaltation	100. complot
21. plumbing				

OF COURSE, YOU ARE A SUPERIOR ADULT

If so, you can give passable definitions of at least seventy-five of the above words The average adult, who does not read the JOURNAL OF HEREDITY, cannot manage more than sixty-five of them. Ability to give seventy-five definitions from the above list indicates the possession of a working vocabulary of 13,500 words.

tests correctly and who is experienced in the psychological interpretation of responses can in forty minutes arrive at a more accurate judgment as to a subject's intelligence than would be possible without the tests after months or even years of close observation. . . Exceptionally superior endowment is discoverable by the tests, however unfavorable the home from which it comes, and inferior endowment cannot be normalized by all the advantages of the most cultured home. Or to quote from William Stern, the greatest German exponent of the psychology of individual differences, "The tests actually reach and discover the general developmental conditions of intelligence, and not mere fragments of knowledge and attainments acquired by chance."

Delinquent Dullards

The same group of tests was given to forty-three members of an aviation corps and fifty inmates of a state penitentiary, by Thomas H. Haines (*Journal of Delinquency*, Sept., 1917). "The aviation men are above average in endowment and training. Three-fourths of them are college men." The penitentiary inmates are the more intelligent and better trained men of their group. "They can all read and write and figure with fair facility." "The median score of the aviation men is 77.7% and the median of the penitentiary men 36.3%. The range of the aviation men was from 57.1% to 90.4% and the range of the delinquents was from 03.8% to 83.3%. There is here further evidence that even the better endowed delinquents are distinctly inferior to such a picked group of talented men as enter the air service." While such men as are found in the average penitentiary could never be made brilliant by any system of education, Dr. Haines thinks that they could at least be made law-abiding, by a proper education. They are capable, not incapable, inferiors.

FEEBLEMINDEDNESS IN DELAWARE

Survey by Children's Bureau Finds Many Mental Defectives, Mostly In Bad Surroundings and Not Properly Cared for—Reduction of the Fecundity of the Socially Inefficient May be the Most Effective Way of Preventing the Multiplication of Feeblemindedness

UNDER what home conditions do mental defectives live? To get a fair picture, the federal Children's Bureau made a study[1] of New Castle county, Delaware, and found that the conditions were very bad indeed.

New Castle is the northernmost of the three counties of Delaware. Containing the large city of Wilmington, it has a population of 131,670, a majority of whom are whites of the old American stock.

While the study was far from thorough, 212 very obvious cases of feeblemindedness were found, and 361 additional who were suspect. Not one in twenty of these persons was receiving proper care, Delaware being one of the few states of the Union which has no provision for its feebleminded.[2]

"The coincidence of mental defect and low grade of environment was striking," says Miss Lundberg, author of the report. But is it a coincidence? She herself probably does not think so; certainly most of those who have given the problem most study think otherwise. The idea that a child has a low grade of intelligence because he comes from a poor home is now held by few, for it is recognized that the home is an index of the kind of people who make it, and that on the average the inferior homes are the expression of germinal inferiority of their occupants.

"The common opinion that the child from a cultured home does better in tests [of intelligence] solely by reason of his superior home advantages is an entirely gratuitous assumption," as Professor Terman says.[3] "Practically all of the investigations which have been made of the influence of nature and nurture on mental performance agree in attributing far more to original endowment than to environment. Common observation would itself suggest that the social class to which the family belongs depends less on chance than on the parents' native qualities of intellect and character.

DIFFERENCES ARE HEREDITARY

"The results of five separate and distinct lines of inquiry based on the Stanford data agree in supporting the conclusion that the children of successful and cultured parents test far higher than children from wretched and ignorant homes for the simple reason that their heredity is better.

"It would, of course, be going too far to deny all possibility of environmental conditions affecting the result of an intelligence test. Certainly no one would expect that a child reared in a cage and denied all intercourse with other human beings could by any system of mental measurement test up to the level of normal children. There is, however, no reason to believe that *ordinary* differences in social environment (apart from heredity), differences such as those obtaining among unselected children attending approximately the same general type of school in a civilized community, affect to any great extent the validity of the scale.

"A crucial experiment would be to

[1] U. S. Dept. of Labor, Children's Bureau, Pub. No. 24. A Social Study of Mental Defectives in New Castle County, Delaware, by Emma O. Lundberg. Washington, 1917, pp. 38.

[2] The only provision in Delaware for the care and training of mental defectives is the State fund for the maintenance of fourteen Delaware children in the Pennsylvania Training School for the Feebleminded Children at Elwyn, Pa.

[3] Terman, Lewis O. The Measurement of Intelligence, pp. 115 ff. Boston, 1916.

take a large number of very young children of the lower classes and, after placing them in the most favorable environment obtainable, to compare their later mental development with that of children born into the best homes No extensive study of this kind has ever been made, but the writer has tested twenty orphanage children who, for the most part, had come from very inferior homes. They had been in a well-conducted orphanage for from two to several years, and had enjoyed during that time the advantages of an excellent village school. Nevertheless all but three tested below average."

"The importance of school instruction to neutralize individual differences in native endowment will be evident to any one who follows the school career of backward children. The children who are seriously retarded in school are not normal, and cannot be made normal by any refinement in educational method. As a rule, the longer the inferior child attends school, the more evident his inferiority becomes. It would hardly be reasonable, therefore, to expect that a little instruction in the home would weigh very heavily against these same native differences in endowment. Cases like the following show conclusively that it does not:

X is the son of unusually intelligent and well-educated parents. The home is everything one would expect of people of scholarly pursuits and cultivated tastes. But X has always been irresponsible, troublesome, childish and queer. He learned to walk at two years, to talk at three, and has always been delicate and nervous. When brought for examination he was 8 years old. He had twice attempted school work, but had accomplished nothing and was withdrawn. His play-life was not normal, and other children, younger than himself, abused him and tormented him. The Binet tests gave an IQ of approximately 75; that is, the retardation amounted to about 2 years. The child was examined again three years later. At that time, after attending school 2 years, he had recently completed the first grade. This time the IQ was 73. Strange to say, the mother is encouraged and hopeful because she sees that her boy is learning to read. She does not seem to realize that at his age he ought to be within 3 years of entering high school.

The 40-minute test had told more about the mental ability of this boy than the intelligent mother had been able to learn in eleven years of daily and hourly observation. For X is feebleminded; he will never complete the grammar school; he will never be an efficient worker or a responsible citizen.

Let us change the picture. Z is a bright-eyed, dark-skinned girl of 9 years. She is dark-skinned because her father is a mixture of Indian and Spanish. The mother is of Irish descent. With her strangely mated parents and two brothers she lives in a dirty, cramped, and poorly furnished house in the country. The parents are illiterate, and the brothers are retarded and dull, though not feebleminded.

It is Z's turn to be tested. I inquire the name. It is familiar, for I have already tested the two stupid brothers. I also know her ignorant parents and the miserable cabin in which she lives. The examination begins with the 8-year tests. The responses are quick and accurate. We proceed to the 9-year group. There is no failure, and there is but one minor error. Successes and failures alternate for a while until the latter prevail. Z has tested at 11 years. In spite of her wretched home, she is mentally advanced nearly 25%. By the vocabulary test she is credited with a knowledge of nearly 6,000 words, or nearly four times as many as X, the boy of cultured home and scholarly parents, had learned by the age of 8 years.

Five years have passed. When given the test Z was in the fourth grade and, as we have already stated, 9 years of age. As a result of the test she was transferred to the fifth grade. Later she skipped again and at the age of 14 is a successful student in the second year of high school. To assay her intelligence and determine its quality was a task of 45 minutes.

In the light of these facts, there is no difficulty in understanding the conclusions at which Miss Lundberg arrived, after her survey of New Castle county:

FEW PROPERLY CARED FOR

"A total of 175, or 82.5% of the cases studied were in need of public supervision or institutional care. Ninety-five of these were at large in the community in immediate need of special care and protection, sixty-eight were in institutions not designed for their care, and twelve were provided for only temporarily in an institution for the feebleminded.

"A study of individual cases of mental defectives reveals in a striking way the coincidence of mental defect and poverty, abnormal home conditions, neglect, and dependency. A majority of the

mental defectives were found in an environment making normal standards of living impossible.

"Eighty-three, or 39% of the total number, were living under adverse home conditions—extreme poverty, alcoholism, immorality, or entire lack of home protection. An additional 68, or 32%, were in institutions not adapted to their needs, making a total of 71% living under conditions where adequate care and protection were impossible or provided for only temporarily in institutions designed to care for other classes.

"That society must provide special protection for mental defectives is strongly indicated by the fact that 98 of the total number studied had delinquency records or were immoral or difficult to control. Seventy-nine of these were living under adverse conditions or in institutions not adapted to their needs, while seven were in an institution for the feeble-minded, and twelve were living in good homes.

"The problem of those requiring special care and training because of subnormal mentality is not limited to the 212 positive cases of mental defect included in this study. The 361 individuals classified as of questionable mentality undoubtedly included a number who were actually mentally defective. All of them presented problems of retardation or abnormality. More than one-third of the questionable cases, for whom information as to individual characteristics was secured, were known to be delinquent or uncontrollable. A total of two-thirds of those for whom detailed data were obtained were in homes where proper care and safeguarding were impossible, or had already developed antisocial tendencies."

"BORN CRIMINALS"

That these feebleminded persons are frequently delinquent or anti-social is inevitable, and has little to do with their evil surroundings, except in so far as these make temptation more frequent. There may not be such a thing as a "born criminal" but the person who is born feebleminded or with a germinal lack of emotional control is so near to a "born criminal" that for practical purposes there is no difference.

Why do the feebleminded tend so strongly to become delinquent? "The answer," Professor Terman says,[4] "may be stated in simple terms. Morality depends upon two things: (*a*) the ability to foresee and to weigh the possible consequences for self and others of different kinds of behavior; and (*b*) upon the willingness and capacity to exercise self-restraint. That there are many intelligent criminals is due to the fact that (*a*) may exist without (*b*). On the other hand, (*b*) presupposes (*a*). In other words, not all criminals are feebleminded, but all feebleminded are at least potential criminals. That every feebleminded woman is a potential prostitute would hardly be disputed by any one. Moral judgment, like business judgment, social judgment, or any other kind of higher thought process, is a function of intelligence. Morality cannot flower and fruit if intelligence remains infantile.

"All of us in early childhood lacked moral responsibility. We were as rank egoists as any criminal. Respect for the feelings, the property rights, or any other kind of rights, of others had to be laboriously acquired under the whip of discipline. But by degrees we learned that only when instincts are curbed, and conduct is made to conform to principles established formally or accepted tacitly by our neighbors, does this become a livable world for any of us. Without the intelligence to generalize the particular, to foresee distant consequences of present acts, to weigh these foreseen consequences in the nice balance of imagination, mortality cannot be learned. When the adult body, with its adult instincts, is coupled with the undeveloped intelligence and weak inhibitory powers of a ten-year-old child, the only possible outcome, except in those cases where constant guardianship is exercised by relatives and friends, is some form of delinquency."

The need of adequate provision for these defectives is discussed at some

[4] *Op. cit.*, p. 11.

length by Miss Lundberg. She points to the necessity for a central institution, for more mental examinations, for special classes in the public schools and paroles and supervision in homes. But it is remarkable that she nowhere specifically refers to the need for striking at the root of the difficulty by lessening the production of these innate defectives.

Proper segregation of the feebleminded, the two sexes being kept separate, would of course cut off those particular lines of descent. But Professor East and Professor Punnett have recently pointed out[5] that if no other measures are adopted than to segregate the patently feebleminded, it will require thousands of years to eliminate even the greater part of this defective germplasm from the American population.

A much more effective way of reducing the burden is opened by the central fact of Miss Lundberg's report, that "study of individual cases of mental defectives reveals in a striking way the coincidence of mental defect and poverty, abnormal home conditions, neglect and dependency." It is not at present possible to tell what individuals carry feeblemindedness latent in their germplasm, so that action may be taken to prevent them from reproducing. But it is very easy to tell what individuals are characterized by poverty, abnormal home conditions, neglect and dependency. Any eugenic measures that tend to lower the birth rate among such people will thereby tend to reduce the number of feebleminded children born every year.

More Remarkable Button-Balls

In the December issue of the JOURNAL, an article from the pen of Dr. R. W. Shufeldt of Washington, D. C., appeared under the title of "Multiple Buttonballs," wherein were summarized his observations on the number of flower heads borne by the common Sycamore or Buttonwood tree (*Platanus orientalis*). Dr. Shufeldt had supposed that the balls were always borne singly, but later decided from the results of further research that double or triple buttonballs were also found, while some containing *seven* balls also was brought to his notice.

These were only found as exceptions, however, and the general rule seemed to hold true that the balls were borne singly. Now, however, even more surprising statements are made in regard to multiple flower-heads. J. C. Blumer, writing from Max, MacClean County, N. D., writes in part as follows:

". . . Reading your note in the JOURNAL OF HEREDITY, I might say that fours in button-balls are not uncommon in the native southwestern sycamore (*Platanus wrightii*). I . . . am under the impression that three balls is the normal number in that species. Sometimes two occur and sometimes four, but usually three, never one, so far as I remember. . . .

"In my opinion, the variation in number of balls, other than that which goes with different species, is due to immediate habitat conditions. In general, trees having an abundant supply of moving water, with fertilizing elements from stock or human habitations added, will have the largest number of fours. It is just as with many other trees, particularly fruit and nut trees, similar factors producing extra fruitfulness."

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[5] East, Edward M. Hidden Feeblemindedness. JOURNAL OF HEREDITY, viii, pp. 215–217. Punnett, R. C. Latent Feeblemindedness. JOURNAL OF HEREDITY, viii, pp. 464–465. The argument of Professors East and Punnett is based on the assumption that feeblemindedness is a Mendelian unit-character, an assumption that the reviewer, for one, does not admit. But whatever the exact manner of inheritance may be, it is certain that the subterranean stream of feeblemindedness can not be dried up merely by drying up the surface seepage.

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FEBRUARY, 1918

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WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, coöperative in nature. It is devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

It owns the Journal of Heredity, which is published monthly and sent free to each member.

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The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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EGYPTIAN COTTON FIELD IN ARIZONA

A field of Arizona Egyptian cotton in blossom on the Pima Indian Reservation. Nearly 35,000 acres of this cotton were grown in 1917 and the value of the crop, in the Salt River Valley alone, was estimated at $5,000,000. Photograph by C. B. Doyle. (Frontispiece.)

A PLANT INDUSTRY BASED UPON MUTATION

Varieties of Egyptian Cotton Have Arisen Largely Through Mutation—Possible Relation Between Mutation and Hybridity—Many Problems Still Left For Solution

THOMAS H. KEARNEY

Physiologist in Charge, Alkali and Drought-Resistant Plant Investigations, Bureau of Plant Industry, U. S. Department of Agriculture

MOST species of crop plants comprise numerous well-marked varieties. How these have originated in the seed-propagated crops is still, in large measure, an unsolved problem. In some cases, however, the evidence points to origin by mutation, a phenomenon analogous to bud-sporting in fruit trees and other vegetatively propagated plants. Mutation manifests itself in the sudden appearance of an individual which differs from the parent stock in one or more strongly heritable characters. If this individual "breeds true," the new characters being uniformly expressed in its progeny generation after generation, a stable new variety will have been produced.

MUTATION HARD TO EXPLAIN

Certain geneticists have endeavored to explain mutation on the basis of Mendelian recombination. It must be admitted that in the familiar case of Oenothera, for example, the attempt has not been completely successful. Nor will this explanation cover the apparently well-authenticated examples of mutation in asexually propagated organisms. The possibility should be considered that mutation is not a simple but a complex phenomenon, which results from different causes in different groups of organisms. In Egyptian cotton, the group discussed in this paper, there is some evidence of a relation between mutation and hybridity, although simple recombination does not afford an adequate explanation of the facts.

DESCRIPTION OF EGYPTIAN COTTON

Before going further into this question, it may be in order to consider briefly the nature and uses of Egyptian cotton and to review the plant breeding work which has led to its commercial production in the United States.

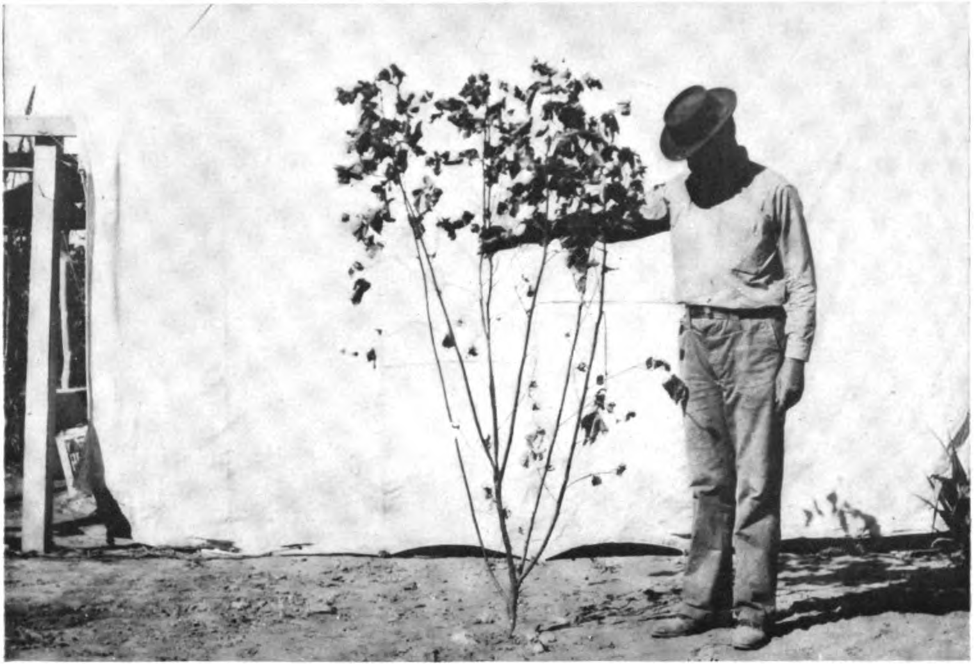
Egyptian cotton differs from any other commercially grown cotton, although showing many points of similarity to the American Sea Island. The parentage of this type, which originated in Egypt about seventy-five years ago, is obscure. Some authorities believe it to have resulted from hybridization of Sea Island with a brown linted African tree cotton, both of which were grown in Egypt during the early part of the nineteenth century.[1] However this may be, the type is now a well-defined one, and while it comprises several distinct varieties, all of these share certain peculiarities which distinguish them from other commonly cultivated cottons.

Commercially, Egyptian cotton is characterized by the superior strength and by the color of the fiber, the latter varying from light brown[2] in some varieties to pale buff or nearly pure white in others.

The length of the fiber ranges, in the different varieties, from $1^1/_{16}$ to $1^3/_4$

[1] See Balls, W. L. The Cotton Plant in Egypt. London, 1912. The origin of the Egyptian type is discussed on pages 3 and 4.

[2] Balbriggan underwear was formerly manufactured only from the undyed fiber of brown Egyptian cotton.



PLANT GROWN FROM NEWLY IMPORTED SEED

The plants grown in Arizona from newly imported seed of Egyptian cotton were unfruitful and late in maturing. (Fig. 1.)

THE RESULT OF SELECTION IN EGYPTIAN COTTON

After several years of selection, a much more productive and earlier strain was developed (Fig. 2).

inches, hence most Egyptian cotton falls into the long staple class (1⅛ inch or longer). The longest Egyptian cotton is surpassed in length only by the best Sea Island.

COTTON CROP OF EGYPT

The cotton crop of Egypt amounts to 500 or 600 million pounds annually, which is approximately one-tenth of the average production of the United States. The best qualities are grown in the Delta, the cotton of the Nile Valley above Cairo being inferior in the quality and length of the fiber. The crop is grown entirely under irrigation.

Cotton is exported from Egypt to of the principal spinning countries. The United States imported last year about 100 million pounds of this cotton. Egyptian cotton is in great demand for the manufacture of goods requiring a high degree of tensile strength, such as sewing thread, durable hosiery, and automobile tire fabrics.

The Department of Agriculture, about twenty years ago, began experiments to determine whether Egyptian cotton could be grown in the United States. Several introductions were made, the most important by Mr. David Fairchild, who visited Egypt in 1899 and obtained seed of the principal varieties then grown in the country. This seed was tested by Dr. H. J. Webber at a number of stations in the southern and southwestern states. For various reasons it was concluded that commercial production in the main cotton belt would be impracticable, but on the irrigated lands of the southwest the results were so promising as to warrant further experimentation.[3]

SELECTION NECESSARY

The behavior of the plants grown from imported seed made it evident, however, that selection would be necessary in order to obtain a sufficiently fruitful, early, and uniform stock to justify commercial production. All of the varieties, when first introduced, were not only relatively late ripening and unfruitful (Fig. 1), but were also extremely variable. This lack of uniformity, as was later pointed out by Mr. O. F. Cook, was due to the fact that the conditions under which cotton is grown in Egypt, favor unlimited cross-pollination in the fields and mixing of seed at the gins.[4] The most serious contamination was due to the abundant presence, as a weed, in Egyptian cotton fields, of the so-called "Hindi." This is a very inferior type, more nearly related to American Upland than to Egyptian cotton, but hybridizing freely with the latter.[5]

EXPERIMENTS BEGUN AT YUMA

Plant breeding experiments were begun by the writer at Yuma, Arizona, in 1903 with Mit Afifi, the variety which at that time was most extensively grown in Egypt. Selection was carried on for several years, resulting in a gradual improvement in the uniformity, earliness and productiveness (Figs. 1 and 2) in the manner in which the bolls opened (Figs. 3 and 4) and in the length of the fiber (Fig. 5). Up to this point, no marked change of type was observed to have taken place.

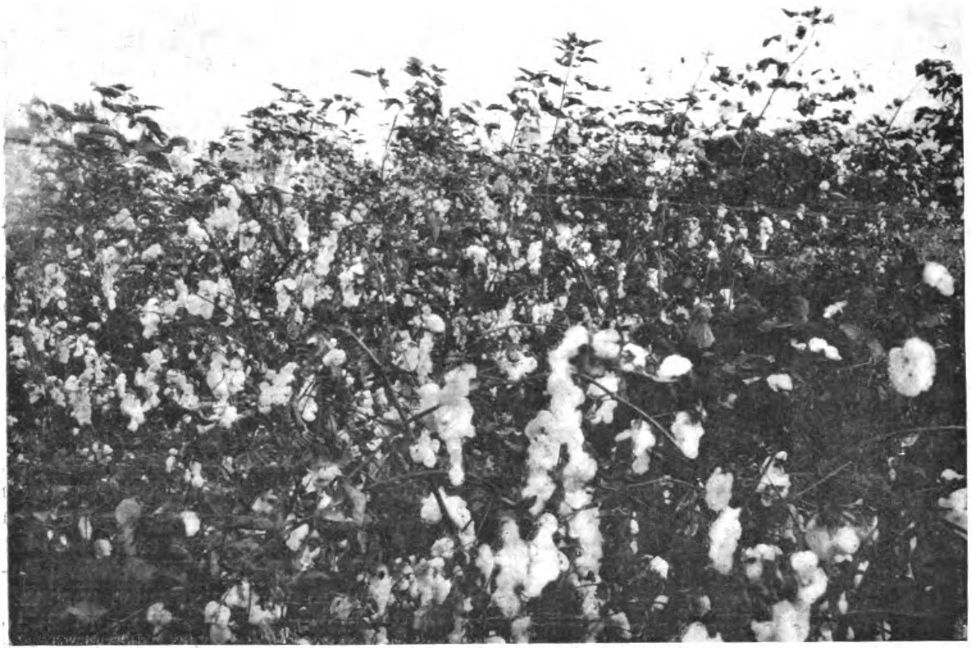
A new era in the breeding work began in 1908 when two of the progeny rows were found to differ strikingly from the parent stock and from one another. These rows gave rise to the Yuma and Somerton varieties. The latter was soon discarded because of its excessive development of vegetative branches or "limbs," but the Yuma variety was preserved and became the basis of the Egyptian cotton industry in Arizona. This variety differed from the parent Mit Afifi in numerous characters, of which the most conspicuous were the longer and more pointed bolls (Fig. 6) and the longer (about 1½ inch) and lighter colored fiber (Fig. 5).

A third variety, the Gila, was

[3] A year or two prior to the commencement of experiments in the southwest by the Department of Agriculture, Egyptian cotton was grown at Phoenix by the Arizona Agricultural Experiment Station and large yields were obtained.

[4] The Government of Egypt has recently taken measures looking to the maintenance of supplies of pure seed.

[5] Cook, O. F. Hindi Cotton in Egypt. Bureau Plant Industry Bulletin 210 (1911).



ARIZONA EGYPTIAN COTTON, RESULT OF SELECTION

Egyptian cotton grown at Yuma, Arizona, after several years of selection, showing the fruitfulness of the plants and the manner in which the ripe cotton hangs from the bolls, making picking easy. (Fig. 3.)

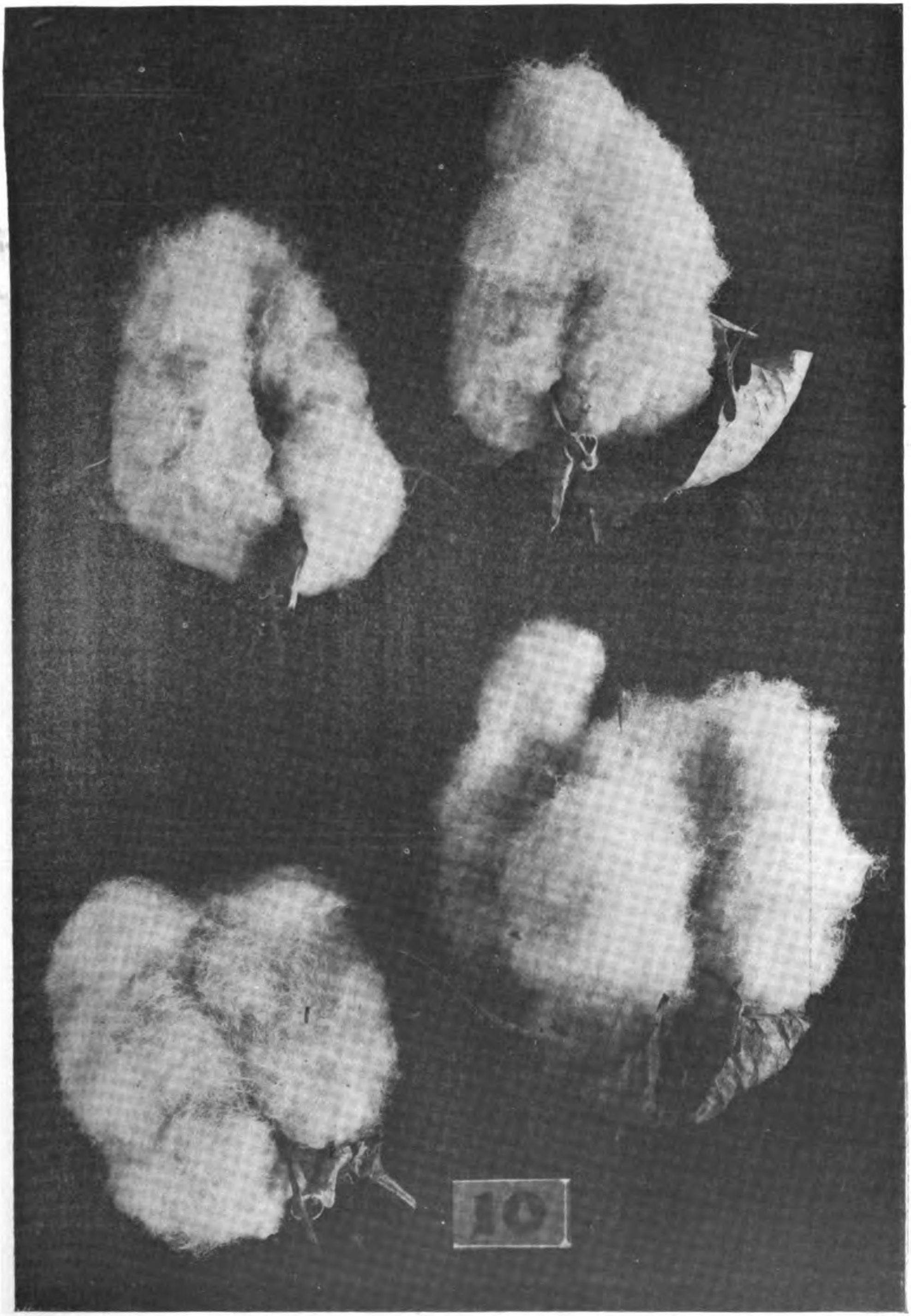
developed by Mr. E. W. Hudson from a plant selected in 1908 in a field of acclimatized Mit Afifi cotton at Sacaton, Arizona. While less different from Mit Afifi than are the Yuma and Somerton varieties, the Gila seemed to be sufficiently distinct to warrant its recognition as a separate variety.

The three Arizona varieties thus far mentioned were all selected out of Mit Afifi. The Pima variety, on the other hand, was derived from Mit Afifi through Yuma. In 1910, in a field of Yuma cotton at Sacaton, Arizona, a plant was selected because of its superior productiveness and length of fiber. Upon examination of the remarkably uniform progeny row which was grown the year following from seed produced by this plant; it was at once evident that another new and very distinct variety had appeared. As compared with the parent variety (Yuma), Pima is distinguished by its fewer vegetative branches and better developed fruiting branches (Figs. 7 and 8), by its plumper, more sharply pointed and less deeply pitted bolls (Fig. 6), and by its longer (1⅝ to 1¾ inch), finer, silkier and lighter colored fiber (Fig. 5).[6]

The commercial production of Egyptian cotton in Arizona began in 1912,[7]

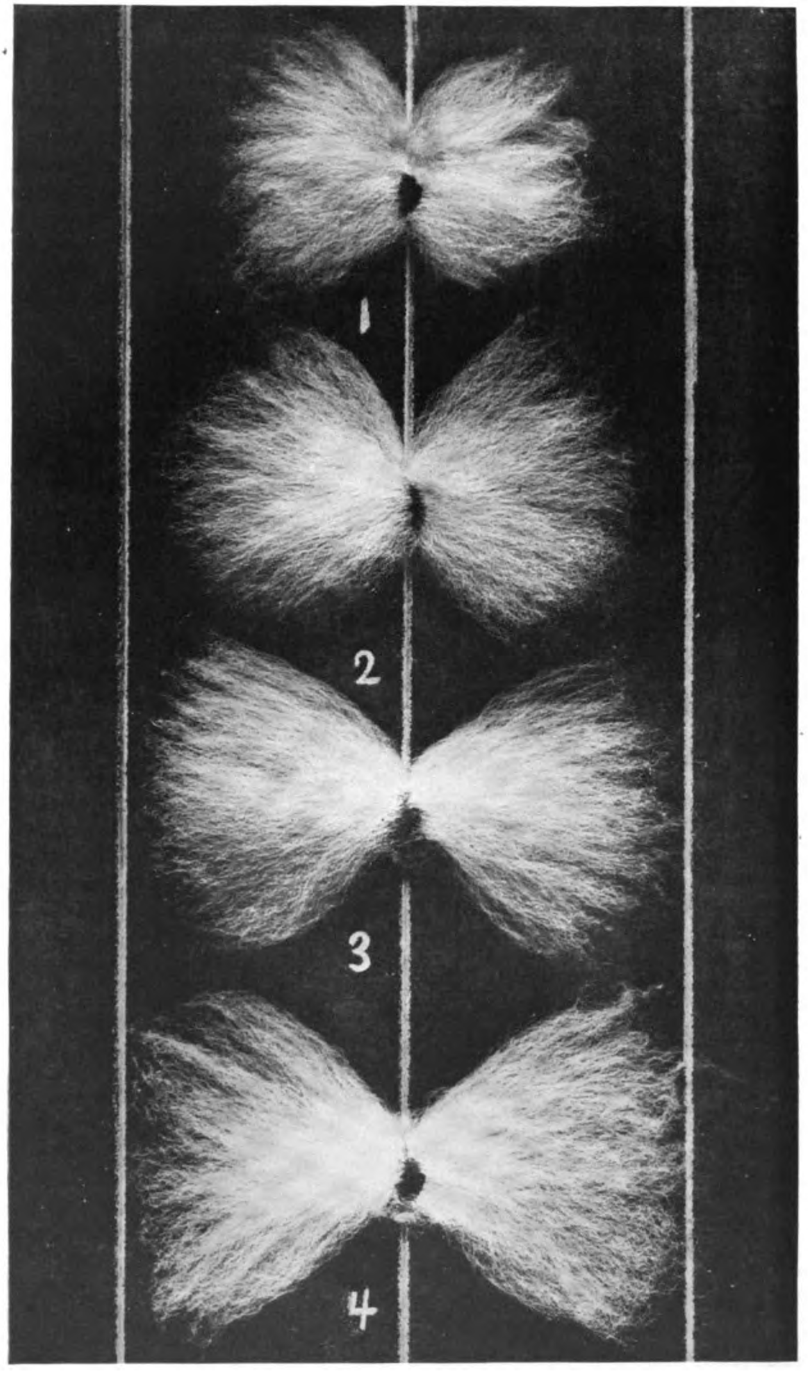
[6] For more complete descriptions of the Yuma, Pima and Gila varieties, see Kearney, T. H. Mutation in Egyptian Cotton. Journ. Agr. Res., Vol. ii (1914), pp. 287-302. Pls. 17-25.

[7] Two years previously, when the complexity of the problems involved in the establishment of this new agricultural enterprise had become apparent, the Chief of the Bureau of Plant Industry appointed a Committee on Southwestern Cotton Culture. The original members of this committee were Messrs. O. F. Cook, C. S. Scofield, W. T. Swingle and T. H. Kearney, all of whom had previously collaborated in various phases of the work. Mr. C. J. Brand, Chief of the Bureau of Markets and Rural Organization, and Mr. K. F. Kellerman, Associate Chief of the Bureau of Plant Industry, subsequently became members of the committee.



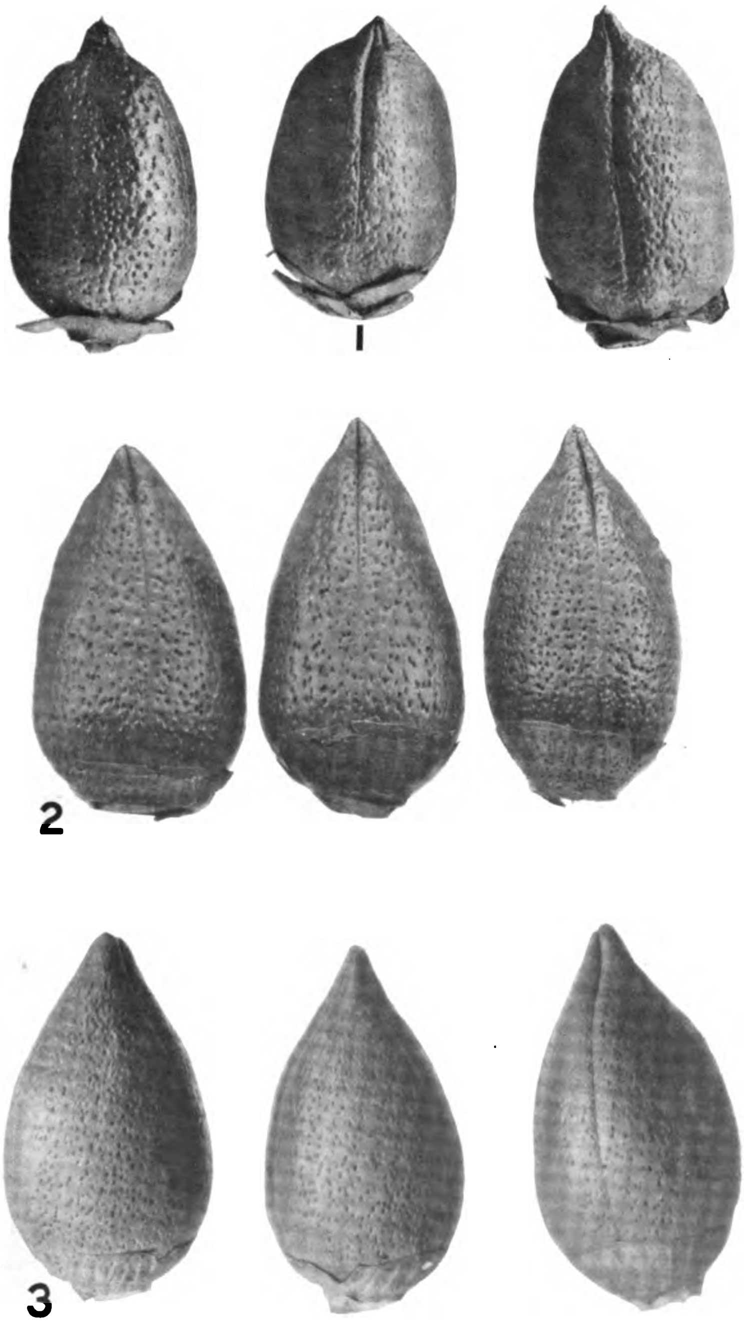
RIPE BOLLS OF THE NEW ARIZONA EGYPTIAN COTTON

Ripe bolls of Arizona Egyptian cotton after several years of selection. On plants grown from newly imported seed the bolls did not open so fully. Egyptian, like Sea Island cotton, has usually 3-locked bolls, while the bolls of American Upland cotton are usually 4-locked or 5-locked. (Fig. 4.)



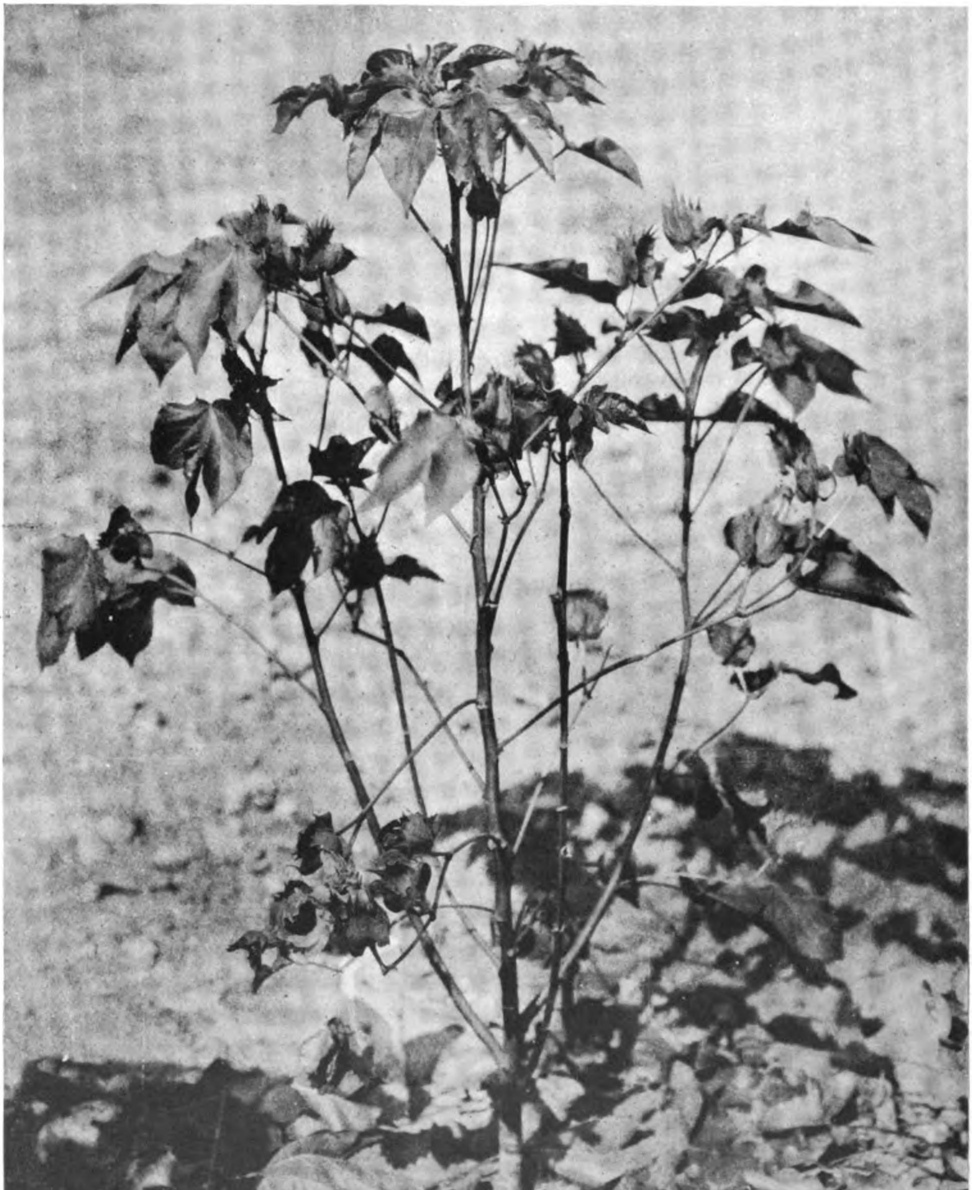
LENGTHENING THE COTTON FIBERS

Egyptian cotton fiber combed out on the seed (slightly reduced from natural size) to illustrate the progress attained by the breeding work in Arizona. The specimens are as follows: (1) From a first selection in the original stock of Mit Afifi; (2) from a strain of Mit Afifi after three years of selection; (3) from the parent plant of the Yuma variety; (4) from a plant of the Pima variety. (Fig. 5.)



UNOPENED BOLLS OF EGYPTIAN COTTON

Showing the differences in shape and in the character of the surface which distinguish the varieties. (1) Mit Afifi; (2) Yuma; (3) Pima. (Fig. 6.)



AN UNDESIRABLE BRANCHING HABIT

A half-grown plant of the Yuma variety with the leaves removed to show the branching habit. The Yuma variety has several large vegetative branches or "limbs" and its lower fruiting branches are often poorly developed. Photograph by C. B. Doyle. (Fig. 7.)

PIMA COTTON PLANT WITH PRODUCTIVE BRANCHING HABIT

The Pima variety differs from the Yuma variety, of which a plant of the same age as this one is shown in Fig. 7, in being often limbless and in having its lower fruiting branches well furnished with bolls. Photograph by C. B. Doyle. (Fig. 8.)

when the Department of Agriculture supplied seed of the Yuma variety to farmers in the Salt River Valley and some 200 acres were planted. From this small beginning the industry expanded until in 1917, in the Salt River Valley alone, about 23,000 acres of Yuma cotton and about 7,000 acres of Pima cotton were grown and the value to the farmers of the fiber and seed produced was estimated at about $5,000,000 (Frontispiece). The prospects are that in 1918 not less than 100,000 acres will be planted to this crop.[8]

The fiber of both the Yuma and Pima varieties has found much favor with American spinners, the automobile tire manufacturers having shown especial interest in this product. The Pima variety, being preferred because of its earliness and its longer fiber, will probably soon completely replace the Yuma.

HOW TO MAINTAIN UNIFORMITY

Although the Yuma variety was very uniform at the outset, as now commercially grown in Arizona it comprises numerous forms which differ markedly from the original type and which "come true" when self-pollinated. This diversity is undoubtedly due to the fact that the original progeny row was not protected from cross pollination with other types. The seed which was subsequently supplied to farmers for commercial planting was the increase from this row, and although the markedly off type plants had been "rogued" from the seed increase fields, the stock was by no means as pure as several generations of line-breeding would have made it. Subsequent experience has shown that a high degree of uniformity can be maintained in the Yuma variety when the latter method is followed.

The Pima variety, having been strictly line-bred and having been kept effectively isolated, has remained uniform. Proof of this was obtained in roguing the seed increase fields during the past three seasons. Although more than two million plants were examined, not a single variant was detected which could be compared, in the magnitude of its departure from the type, with the parent plants of the Yuma and Pima varieties.

FARMERS COÖPERATING

A coöperative association of cotton growers in the Salt River Valley, assisted by the Department of Agriculture, is strenuously endeavoring to maintain the purity of the Pima variety by isolation of the seed increase fields and by separate ginning. Since it has never been proven that a stock of cotton, if free from hybrids at the outset, will "run out" white as it is protected from crossing with other sorts, there is good reason to expect that deterioration of this valuable variety can be indefinitely postponed.

ORIGIN BY MUTATION

The mutational origin of the four varieties of Egyptian cotton which have been developed in Arizona is indicated by the following facts. Each variety was derived from a single plant which appeared suddenly and differed conspicuously in several characters from the parent stock. Intermediate forms were not observed. The progenies of these plants remained uniform in their expression of the new characters, so long as cross-pollination with other forms was prevented.

Origin by mutation seems also to be fairly well established in the case of the numerous varieties which have arisen from time to time in Egypt, although the records are less complete than those of the Arizona varieties. Four varieties of comparatively recent origin, Abbassi, Yannovitch, Nubari, and Sakellaridis, are each reported to have been derived from a single plant selection in a field of Mit Afifi. All of these varieties appear to have been relatively uniform when first grown, but have rapidly deteriorated through cross pollination

[8] For a more complete account of the development of the Egyptian cotton industry in Arizona the reader is referred to U. S. Department of Agriculture Bulletin 332 (1916), entitled Community Production of Egyptian Cotton in the United States.

and seed mixture. Consequently the maintenance of the Egyptian type of cotton has until recently depended upon the successive appearance of desirable mutants which have given rise to new varieties.

It is a noteworthy fact that mutation in Egyptian cotton is associated with lack of purity in the parent stock. From the Mit Afifi, which, like all varieties grown in Egypt, has become a congeries of biotypes, the parents of several well-marked varieties have been selected in Egypt and in Arizona. Similarly the Yuma variety offers numerous heritable variations and has given rise to one very distinct new variety, the Pima. On the other hand in the Pima variety, which has been protected from cross-pollination with other stocks, no conspicuous mutant has yet been detected. Nor have mutants been found in such stocks of the Yuma, Gila and Sakellarides varieties as have been line-bred.

While mutation in Egyptian cotton has been observed only in heterozygous stocks, the origin of such extreme mutants as Yuma and Pima can scarcely be explained by the recombination hypothesis. Comparison of the parent stock with any other with which it could have had recent opportunity to hybridize did not reveal the source of the distinguishing characters of the mutant. Furthermore, the absence or extreme rarity of forms intermediate between parental type and mutant does not accord with the current conception of recombination.

It will be asked whether the origin of varieties in other types of cotton is likewise due to mutation. How, for example, have the almost innumerable varieties of American Upland cotton come into existence? The data at hand do not allow of a positive answer to this question, although it seems to be fairly well established that many of the Upland varieties have been derived from single-plant selections. The presumption that these plants were mutants is not a far-fetched one, since it would seem improbable that Egyptian is the only type of cotton which is in a mutating condition.

Why the Button-Ball Degenerates in Towns

To the Editor of Journal of Heredity:

I have followed with much interest your articles on Platanus. I am tempted to write this letter by a question in your issue of December, 1917, page 553.

Prof. Augustine Henry, Royal College of Science for Ireland, Dublin, asks:

"Can anyone explain how the native species of Platanus is inferior to the imported one, and why the latter is preferred? How the former degenerates when planted in American towns?"

The native species, *Platanus occidentalis*, requires a rich, deep and somewhat sandy soil in which it grows to great size. I have seen trees from 4 to 5 feet in diameter growing along the streams in eastern Kansas. Some that were reduced to saw logs proved to be sound to the core. When planted on the heavy soil of uplands, or in towns where stones, brick-bats, ashes and other similar material are mixed with the already poor soil, the species has a very hard time of it and is generally sickly and short-lived.

Platanus orientalis is naturally more vigorous and of quicker growth; it does not object to the heavy soils, excepting when there is too much alkali present.

This has been my experience during many years of close observation.

Yours very sincerely,

E. F. A. Reinisch,
Supt. of Parks,
Topeka, Kans.

WHY THE BABIES DIE

Supposition That High Infant Mortality in Slums is Due to Poverty is Largely Fallacious—Poverty and Its Attendant Evils Rather Due to Inherent Mental and Physical Defects—Infant Mortality Fundamentally a Problem of Eugenics

THE EDITOR

MANCHESTER, New Hampshire, is a manufacturing town with a population of 70,063 (census of 1910), of whom only 20% are native white of native parents. It is largely devoted to the textile industry. Among other claims to fame, it has one of the highest infant mortality rates in the United States—of every 1,000 babies born, no less than 193 die before the end of their first year. For the United States registration area as a whole, the infant mortality rate is 124, and in many cities it is below 100.

The Children's Bureau (Department of Labor, Washington, D. C.) chose Manchester as the scene of an investigation of infant mortality, because

> It had an usually high infant mortality rate, it was within the registration area for births and deaths so that records for those were available, and it presented conditions which usually are associated with high infant mortality—namely, a large foreign population and a considerable proportion of industrially employed women.

The results are published[1] in Bureau Publication No. 20.

The method of conducting the study showed great care. Between Nov. 1, 1912, and Oct. 31, 1913, there were 2,152 births registered in the city. These infants were followed through twelve months, and a large amount of information secured about their parents. Many of the babies disappeared, so the study is actually based on the history of 1,643 infants (79 of them stillborn). After more than 100 pages devoted to a description of the results of their study, the investigators present the following summary:

Infant Mortality Rate.—The infant mortality rate of 165 for the whole group of 1,564 live-born infants is strikingly high. Not only is it higher than the rate of 124, computed in 1910 for the general registration area of the United States, and higher than that of 101.8 in 1913 for New York City with all its congestion and large foreign element, but it is also several times as high as the rates found in certain foreign countries.

Environment.—Bad housing and insanitary environment, in so far as they existed, were accompanied by high infant mortality rates. These conditions were confined to relatively few areas and were not generally prevalent throughout the city. They are, however, likely to become worse and more extensive in the future unless controlled by adequate restriction.

Low Earnings.—Low earnings of the father indicate in general a low economic status for the family, and in Manchester they were accompanied by a high infant mortality rate. As the father's earnings increased the rate declined substantially.

Mother's Employment.—Gainful employment of the mother existed principally when the earnings of the father were low. Such employment away from home usually necessitated artificial feeding and was accompanied by an infant mortality rate higher than that accompanying low earnings of father.

Nationality.—Babies of foreign-born mothers had a higher rate than those of native mothers, largely on account of the numerous deaths among babies of French Canadian mothers. The French Canadians as a group, however, occupied

[1] Infant Mortality. Results of a field study in Manchester, N. H., based on births in one year. By Beatrice Sheets Duncan and Emma Duke. Infant Mortality series No. 6, Bureau Publication No. 20, pp. 134, with illustrations and maps. Washington, 1917.

a generally higher economic status than other foreign born, and gainful employment of the mother was found to a less extent among them. Their high death rate may be accounted for in part by their large families and the prevalence of artificial feeding.

Large Families.—In general the later-born children have a greater tendency to a high infant mortality rate than those earlier born. Large families were found chiefly among the French Canadians and among the lower economic groups of other nationalities. The mortality rate among all babies ninth and later in order of birth is considerably higher than the rates for those earlier born in either of these groups with unfavorable rates.

Artificial Feeding.—Artificial feeding was accompanied by a higher infant mortality rate than breast feeding. Feeding methods reflect standards and customs and the opportunity of the mother to care for the baby. Artificial feeding was practiced most extensively by mothers gainfully employed away from home; by native mothers in the lowest economic class; and by the French Canadians. In each of these groups other conditions coincident to a high infant mortality rate are also present. In the highest economic group, where the food is more likely to be prepared in accordance with instructions of physicians and where other unfavorable conditions tending to produce a high rate are absent, the rates for breast-fed and artificially fed babies are both low, with a slight difference in favor of the breast-fed baby.

DANGER OF MISINTERPRETATION

What is the moral? Obviously, that if bad housing and insanitary environment are improved, if the wage earners are paid more, if the employment of mothers is eliminated, if the large families are obviated by birth control, a considerable decrease in the infant mortality is to be expected. The authors of the bulletin take care not to make such statements, but it would be difficult to read the bulletin without coming to those conclusions; and as the infant mortality movement is firmly committed to such conclusions already, it is certain that this bulletin will be used as a confirmation of the generally accepted doctrine that improvement of environmental conditions is the great panacea for infant mortality.

Such being the case, the publication of this bulletin by the Children's Bureau must be regarded as unfortunate, for many of the conclusions that will be drawn from it are fallacious and dangerous.

A slight knowledge of sound scientific method and of the data of eugenics is sufficient to cause one to discount very heavily this study of the infant mortality of Manchester. The citation of a single piece of evidence will serve to indicate the correct interpretation.

It is suggested (more frequently, it is clamorously asserted) that bad environmental conditions are the main cause of high infant mortality. Suppose, then, that infant mortality be investigated under *good* environmental conditions. The royal families of Europe offer an excellent field for this study. Here, it will probably be admitted, the environment is as good as knowledge and wealth can make it. A child might conceivably die there from bottle-feeding, but certainly not from bad housing, employment of mother, inadequate wages of father, or lack of care. What is the death-rate in this caste?

The actual figures of infant mortality are not available, but A. Ploetz[2] compiled the figures for child mortality (first five years of life), which are equally instructive. Classifying the deaths of 3,210 children, he correlated them with the age of death of the child's father. Table I shows the result.

INFLUENCE OF HEREDITY

It is evident that there are wide differences in the amount of child mortality. It is evident that there can be no differences in the environment which would account for these differences in the death-rate. It is evident that they

[2] Ploetz, A. Lebensdauer der Eltern und Kindersterblichkeit. *Archiv für Rassen- und Gesellschafts-Biologie*, vi (1909), pp. 33-43.

TABLE I.—*Length of Li:e of Fathers and Child-mortality of Their Children in Royal and Princely Families, Ploetz's Data*

	Year of life in which fathers died								
	16–25	26–35	36–45	46–55	56–65	66–75	76–85	86 up	At all ages
No. of children.............	23	90	367	545	725	983	444	33	3210
No. who died in first 5 years.	12	29	115	171	200	254	105	1	887
Per cent who died...........	52.2	32.2	31.3	31.4	27.6	25.8	23.6	3.0	27.6

are closely associated with the differences in longevity of the father.[3]

Longevity is a measure of soundness of physical constitution—of vitality and, to a large extent, of inheritable vitality. The table admits of but one explanation. There is a low death-rate among children who inherited sound constitutions; there is a high death-rate among children who inherited weak constitutions; and in the latter case this inherited handicap cannot be removed by the best possible environment.

If the interpretation here given is correct, the conclusion is inevitable that child mortality is primarily a problem of eugenics, and that all other factors are secondary. There is found to be no warrant for the statement so often repeated in one form or another, that "the fundamental cause of the excessive rate of infant mortality in industrial communities is poverty, inadequate incomes, and low standards of living."[4] Royalty and its princely relatives are not characterized by a low standard of living and yet the child mortality among them is very high—somewhere around 400 per 1000, in cases where a parent died young. If poverty is responsible in the one case, it must be in the other—which is absurd. Or else the logical absurdity is involved of inventing one cause to explain an effect today and a wholly different cause to explain the same effect tomorrow. This is unjustifiable in any case, and it is particularly so when the single cause that explains both cases is so evident. If weak heredity causes high mortality in the royal families, why, similarly, cannot weak heredity cause high infant mortality in the industrial communities? I believe it does, and that the inadequate income and low standard of living are largely the consequences of inferior heredity, mental as well as physical.

The careful investigation of Mary Beeton and Karl Pearson, with altogether different material, fully confirms the results of Dr. Ploetz' study, and leaves no room for doubt that the mortality among children is largely dependent on their inheritance.[5] If the parents have inherently weak constitutions, or minds, no measures known to science can endow their children with strong physique and mentality.

BASIS FOR SOLVING PROBLEM

If the infant mortality problem is to be solved on the basis of knowledge and reason, rather than emotion and rhetoric, it must be recognized that sanitation and hygiene can not take the place of eugenics any more than eugenics can dispense with sanitation and hygiene. It must be recognized that the death-rate in childhood is largely selective, and that the most effective way to cut it down is to endow the children with better constitutions. This can not be done solely by any euthenic campaign; it can not be done by swatting the fly, abolishing the midwife, sterilizing the milk, nor by any of the other panaceas sometimes proposed.

But, it may be objected, this discus-

[3] And also of the mother. Dr. Ploetz presents tables for both parents, and for several social classes. The one reprinted in this review is the most crucial but all of them are in good agreement.

[4] Hibbs, Henry H., Jr. Infant Mortality: Its Relation to Social and Industrial Conditions, New York, 1916.

[5] *Biometrika* I, p. 60.

sion ignores the actual facts. Statistics show that infant mortality campaigns *have* consistently produced reductions in the death rate. The figures for New York, which could be matched in dozens of other cities, show that the number of deaths per 1,000 births, in the first year of life, has steadily declined since a determined campaign to "Save the Babies" was started:

1902	181
1903	152
1904	162
1905	159
1906	153
1907	144
1908	128
1909	129
1910	125
1911	112
1912	105
1913	102
1914	95

To one who cannot see beyond the immediate consequences of an action, such figures as the above indeed give quite a different idea of the effects of an infant mortality campaign, than that which I have just tried to create. And it is a great misfortune that euthenics so often fails to look beyond the immediate effect, fails to see what may happen next year, or ten years from now, or in the next generation.

It must be admitted that it is possible to keep a lot of children alive who would otherwise have died in the first few months of life. It is being done, as the New York figures, and pages of others that could be cited, prove. The ultimate result is two-fold:

RESULTS OF CAMPAIGNS

1. Many of those who are doomed by heredity to a selective death, but are kept alive through the first year, die in the second or third or fourth year. They must die sooner or later; they have not inherited sufficient resistance to survive more than a limited time. If they are by a great effort carried through the first year, it is only to die in the next. This is a statement rarely observed in the propaganda of the infant mortality movement; and it is perhaps a disconcerting one. It can only be proved by refined statistical methods, but several independent determinations leave no doubt as to the fact.[6] Nature is weeding out the weaklings, and in proportion to the stringency with which she weeds them out at the start, there are fewer weaklings left to die in succeeding years. To put the facts in the form of a truism, part of the children born in any district in a given year are doomed by heredity to an early death; and if they die in one year they will not be alive to die in the succeeding year, and *vice versa*. Of course, there are in addition infant deaths which are not selective and which if prevented would leave the infant with as good a chance as any to live.

In the light of these researches, one must conclude that baby-saving campaigns accomplish less than is thought; that the supposed gain is to some extent temporary and illusory.

2. There is still another consequence. If the gain is by great exertions made more than temporary; if the baby who would otherwise have died in the first months is brought to adult life and reproduction, it means in many cases the dissemination of another strain of weak heredity, which the bloody hand of natural selection would have cut off ruthlessly in the interests of race betterment. In so far, then, as the infant mortality movement is not futile, it is, from a strict biological viewpoint, often detrimental to the future of the race.

BUT BABIES MUST BE SAVED

Do we then discourage all attempts to save the babies? Do we leave them all to natural selection? Do we adopt the "better dead" gospel?

Unqualifiedly, no! The sacrifice of the finer human feelings, which would accompany any such course, would be a greater loss to the race than is the eugenic loss from the perpetuation of weak strains of heredity. The abolition of altruistic and humanitarian sentiment for the purpose of race betterment would ultimately defeat its own end by making race betterment impossible.

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[6] The work was done by E. C. Snow, Karl Pearson and Ethel M. Elderton. A brief review of it will be found in the JOURNAL OF HEREDITY, vi, pp. 497–498, Nov., 1915.

But race betterment will also be impossible unless a clear distinction is made between measures that really mean race betterment of a fundamental and permanent nature, and measures which do not. . . . Such publications as this bulletin of the Children's Bureau are unfortunate because they serve, even though quite unintentionally, to confuse the issue. If the national well-being is to be furthered, it is necessary frankly to realize that the present methods of "saving the babies" are wholly inadequate. They must be extended. There is only one fundamentally effective and permanent way of reducing infant mortality—namely, by starting the babies in life with good heredity.

The Position of Women After the War

MOTHERHOOD. By C. Gasquoine Hartley (Mrs. Walter M. Gallichan). Pp. 402, price $2.50. Dodd, Mead & Co., 443 Fourth Avenue, New York City.

Writing from an English point of view, Mrs. Gallichan remarks that the war has brought about numerous, large and divergent changes in the position of women. On the one hand, it has forced great numbers of them into industry, making them economically independent; on the other hand, it has (she says) practically destroyed the feminist movement, women having come to realize that motherhood is above all else the thing that counts. After reviewing at length the evolution of parental instinct, she devotes the larger part of the book to a discussion of ways in which the home can be strengthened and motherhood conserved. This carries her to the familiar ground of sexual education, divorce, position of the unmarried mother, etc. While believing that life-long monogamy is best suited to the normal part of the race, Mrs. Gallichan thinks that there are many abnormal individuals for whom freer and more temporary unions should be legalized. But legal sanction for such changes is not sufficient—what is really wanted, in most cases, is social sanction; and this is a thing which can not be manufactured to order.

Vocational Guidance in Music

Vocational and avocational guidance has heretofore been planned largely along physical lines and although the psychological requirements have been recognized as important, it has always seemed impossible to measure satisfactorily a subject's mental capabilities along a given line. Now, however, a field has been discovered which promises to form a well defined phase of applied psychology. In its monthly monograph for September, 1916, and again in its bulletin of October 6, 1917, the University of Iowa describes the work which is being done there in vocational guidance in music. After a number of years' work the Psychology of Music Studio has set forth definitely the traits which make the talent for music a "gift" and is now able to measure them so accurately that the fitness of a subject for musical work can be determined exactly, and the nineteen measurements made can be charted on a graph. The laboratory-studio is maintained at the University for the service of the people of the State and a small fee of three dollars is charged for making the examination, which extends over a period of three days. It is planned to make musical surveys in the public schools, especially in the fifth grade, and as some of the fundamental tests are so arranged that it is possible to give them to one hundred children at a time, it will be comparatively easy to make an accurate classification. The plan aims to discover latent talent as well as to classify ambitious students.

SMALL GRAIN INVESTIGATIONS

Work Conducted by the Department of Plant Breeding at Cornell University[1]—Report Should Stimulate Interest—Coöperation Between Institutions Important

H. H. LOVE and W. T. CRAIG

In Coöperation With the Office of Cereal Investigations, U. S. Department of Agriculture

THE authors think it advantageous for workers in different laboratories to publish a brief outline of lines of investigation together with some of the results obtained. A very interesting outline was given in this Journal by H. D. Hughes of the Iowa State College. Such reports stimulate interest in the various lines of work and give all a better idea of the kinds of experiments under way in the several institutions.

The small grain work of the Department of Plant Breeding at Cornell University is conducted in coöperation with the Office of Cereal Investigations. The principal lines of work may be divided as follows:

The comparison of varieties, pure line selections and selections from hybrids of wheat, oats, barley and rye.

Pure line breeding work with selections from wheat and oats.

Variation and correlation studies with the different cereals.

Hybridization work with wheat, oats, rye and barley.

VARIETIES COMPARED

Under the first heading the work has been directed toward improving yield and other desirable qualities of the small grains. As a basis for this work, comparative trials have been made of the already existing varieties to determine the most desirable ones. Selections have been made from these and from fields throughout the State and, when multiplied, compared directly with the best varieties. While these selections are being made and tested any new commercial sorts offered by seedsmen that seem promising are obtained for the comparative trials also. The selections are first tested in head rows, then in the rod rows and finally in plats. (Figs 9, 10 and 11.) A very large number of wheat, oat, barley and rye selections have been made. In addition to selection, hybridization is also used as a means of obtaining better sorts and a large number of hybrids are now under test.

Any sorts that seem worth while in the comparative trials have been distributed to farmers for comparison with the sorts they are growing. A number of selections have been obtained which have given promise of being worthy of cultivation commercially, in fact, certain of these are already being grown by the farmers of the State. The work with wheat and oats has been under way longer so that at present more of these sorts have been under test and distributed to farmers.

RESULTS ARE COMPREHENSIVE

The results obtained by selecting high yielding types of oats from varieties may be shown by the following table. In this table only a few of the selections are shown. These results have been obtained on the trial grounds of the Agricultural Experiment Station at Ithaca, New York.

[1] Paper No. 67, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

ROWS OF WHEAT FROM SELECTED HEADS

This is the first stage in the testing of promising selections. Later they are tested in rod rows and finally in plats. (Fig. 9.)

TABLE 1.—*Results obtained by selecting oats for increased yield. The average yield in bushels per acre for three years is presented for the variety and selections.*

	3 Year average yield	*Gain of selection over the variety*
Canada Cluster.........	56.9	...
Canada Cluster, 110-36..	65.6	8.7
Lincoln................	53.2	...
Lincoln, 109-14.........	57.4	4.2
Lincoln, 109-15.........	58.4	5.2
Big Four.............	52.4	...
Big Four, 115-27.......	58.3	5.9
Big Four, 115-40.......	57.9	5.5
Clydesdale............	50.2	...
Clydesdale, 114-2.......	56.7	6.5
Clydesdale, 114-4.......	57.1	6.9
Clydesdale, 114-14......	57.8	7.6
Clydesdale, 114-16......	58.0	7.8

Here it is seen that considerable increase has been obtained by isolating the higher yielding pure lines from these commercial varieties.

As stated before seed has been distributed to farmers and they sow plats of the seed furnished by us and similar plats from seed they are accustomed to use. From these trials reports of increases in yield are made in a number of cases, some reporting a gain as high as 12 or more bushels of wheat over the common sorts of the community and increases as high as 20 and 25 bushels of oats are reported.

PURE LINE BREEDING

In order to test the effect of selecting the best plants from a pure line of the small grains an experiment was planned with oats. A pure line of oats was grown on uniform soil and data were taken as to height, length of head and number of internodes. From these plants seed of certain of the tallest and shortest plants were grown again on uniform soil. These were again studied statistically, keeping the offspring from each parent plant in separate lots, thus having several tall and several short lines. From the tall and short lines tall and short plants have been selected and tested each year for five years. In addition to selecting tall plants from tall lines short plants were also selected

from certain of the tall lines to see whether they reproduced shorter offspring than did the tall plants. Each year the grain has been saved so that further studies may be made if desired.

The effect of thus selecting plants may be shown by the following general summary showing four years' work. In this summary the height of the parent plants is given, together with the height of the resulting line in each case. The average of the parent plants, as well as the average height of the offspring, is given for each year.

Year	Average height of parents selected in cm.		Average height of offspring produced in cm. from	
	Tall line	Short line	Tall line	Short line
1913....	85.8	58.8	74.2	75.7
1914....	86.9	60.4	82.6	82.9
1915....	94.9	67.8	89.4	88.8
1916....	97.1	74.9	95.9	94.5
Average.	91.2	65.5	85.5	85.5

From this table it is clear that, although the average height of the parent plants selected differed by 25.7 centimeters, the offspring from the tall and short parents gave the same average height. It is clear then that for oats at least it is not possible in a few years to change the type by selecting parent plants within a pure line.

VARIATION AND CORRELATION

The variation and correlation studies have been made first to determine the amount and nature of variation and correlation with oats and wheat in order to see what use such information may be to plant breeding. A second line of study has been to determine what effect environment has upon the variation and correlation constants. These studies have been of a statistical nature and have dealt with such characteristics as height of plant, number of kernels, weight of kernels, number of spikelets, and the like. They have shown briefly that:[2]

Environmental conditions such as exist in different years cause changes in the means. Conditions that generally result in reduction of plant yield also result in reduction of height, number of kernels, and number of culms, but in increase in size of kernels.

Yield is reduced by decrease in number of kernels produced, rather than by decrease in their size.

Variability decreases with decrease in the means.

Correlations are more or less responsive to environmental conditions, and may be divided into fluctuating and stable, according to their behavior under differing environments.

There are high, positive, and fairly stable correlations between average height of plant and (*a*) total and average yield, (*b*) total and average number of kernels produced, (*c*) average number of spikelets per culm; the correlations between average height of plant and (*d*) average weight of kernels, (*e*) number of culms, are fluctuating, being high or low on occasion.

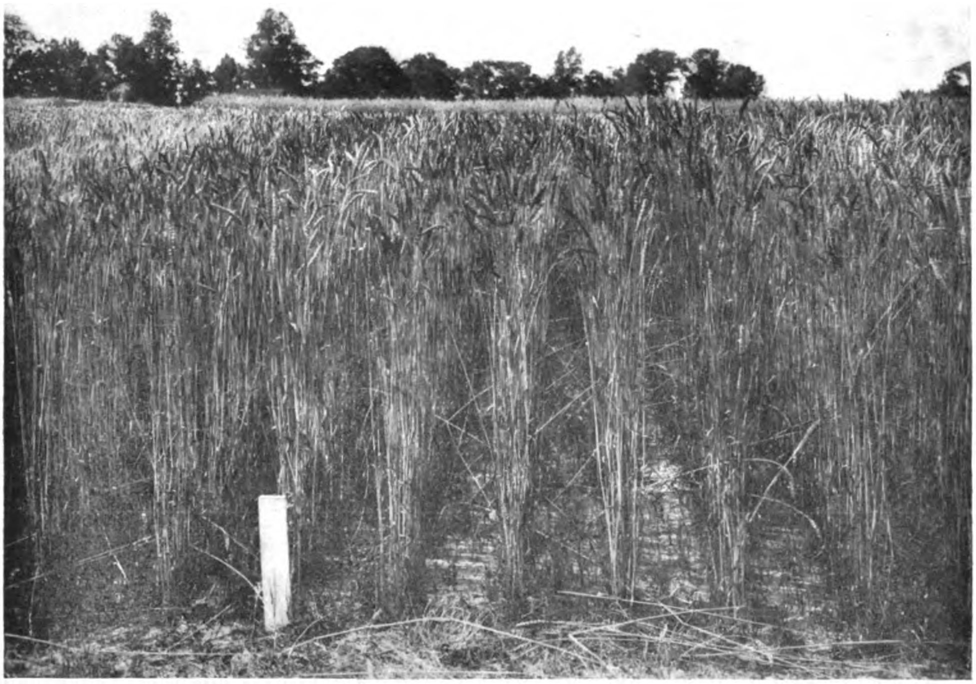
There are high, positive, and stable correlations between total yield and (*a*) culm yield, (*b*) total and average kernel production, (*c*) spikelet production, (*d*) culm production.

The average kernel weight is not correlated closely and consistently with any other character here considered, except average culm yield, with which the correlation is fairly high and fairly consistent.

The average number of spikelets per culm per plant is correlated (*a*) fairly highly with the average number of kernels per spikelet; (*b*) apparently very highly with number of kernels per culm; (*c*) very highly and stably with average height of plant and total yield; and (*d*) in a fluctuating manner with kernel weight.

The correlations between number of culms per plant and (*a*) height, (*b*) culm yield, (*c*) number of kernels, are fluctuating, varying greatly from high to low; between number of culms per plant and (*d*) total yield they are high, positive, and stable; between number of culms per plant and (*e*) average

[2] Memoir No. 3, Cornell University Agricultural Experiment Station.



WHEAT SELECTIONS IN ROD ROWS

The second stage in the process of testing promising selections is here illustrated. The test is completed by growing the selections in plats. (Fig. 10.)

kernel weight they are fairly stable and always low.

To determine the difference that exists between varieties, studies have been made with certain types.[3] Four varieties were used in this study, namely, Great American, Early Champion, Welcome and Sixty Day. The results may be briefly stated in the following paragraph.

In this study, considerable difference is shown in average yield of culm per plant. This is due to the larger kernels produced by certain varieties, since the number of kernels and of spikelets are about the same for the different varieties. There are varietal differences in the height of culm. The average number of kernels per spikelet is greatest in the Sixty Day and smallest in the Early Champion variety. The proportion of straw to grain differs in the different varieties. Considerable difference is found in the amount of variability of different characters of the varieties. The greatest variability, in all characters but one, is found in the Welcome variety, while each of the others is least variable in one or more characters. The coefficients of correlation are usually fairly close together for the different varieties, but some differences occur that may be due to varietal causes.

COÖPERATIVE WORK DONE

In order to learn the further effect of environments which differ greatly a coöperative study has been arranged between the Montana Agricultural Ex-

[3] Memoir No. 4, Cornell University Agricultural Experiment Station.

INCREASE PLATS OF WHEAT

Striking contrasts are evident among the various plats in respect to the size of the plants. (Fig. 11.)

periment Station and our department. The work is done jointly by Professor Alfred Atkinson and ourselves. Each year seeds are exchanged between the two places for comparison with the locally grown seeds. This experiment is now five years old and results will soon be ready for publication.

Another coöperative experiment of a similar nature with wheat has been arranged between Professor W. C. Etheridge of the Agronomy Department of the University of Missouri and our department.

HYBRIDIZATION WORK

The experiments in hybridization are two-fold in nature. They are planned to study the mode of inheritance of the various quantitative and qualitative characters while at the same time any types that give promise of being of commercial value are saved for comparison with standard sorts. Fig. 12 shows the method of harvesting hybrids in the field. These studies have been under way since 1910 and are furnishing much valuable data.

With oats such characters as color of glume, pubescence on the glume, basal pubescence, kind of awns, presence of awns, articulation, ligule and hull-lessness are being studied. Numerous crosses between the various domestic or cultivated oats have been made as well as crosses between the different wild forms. So far as possible all of the important species are being used in these crosses.

Various colors have been studied and some interesting facts have been determined. It has been found in crosses between the Sixty Day oat and the wild Avena fatua that the yellow color of the Sixty Day inhibits the production of well-developed awns and pubescence on the glumes. These crosses have also shown that different types are found among the fatua. One sort when crossed with the White Tartar King gives 15 pubescent to 1 non-pubescent plants in the second generation while another type produces a ratio of 3 pubescent to 1 non-pubescent. Two forms of black oats classed as the same variety give white glumed

HARVESTING THE WHEAT HYBRIDS

The rest of the test includes only laboratory methods for this generation. (Fig. 12.)

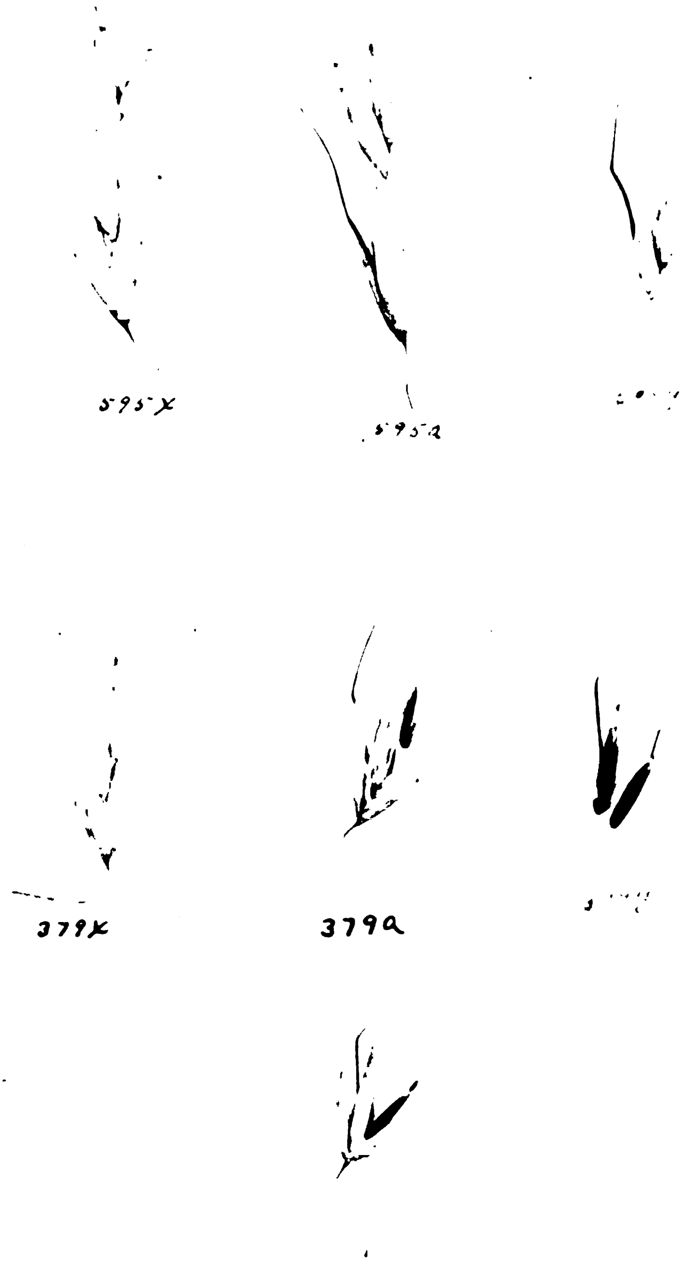
plants in the second generation in the ratio of 15 black to 1 non-black.

Crosses between the hulled and naked oats show that nakedness behaves as a simple monohybrid, giving 1 naked, 2 intermediate to 1 hulled. However, the intermediate forms show all gradations of the naked condition. Some will be nearly all of the naked type while others will be nearly all of the hulled type. These different heterozygous types have been tested in further generations and, while they reproduce the 1:2:1 ratio, nevertheless, they produce heterozygous forms which differ as to the percentage of hulled kernels. The percentage of hulled kernels is high or low, depending on the type of parent form chosen. Those having a high amount of hulled reproduce this type. Thus, while the ratio obtained in this cross is apparently a simple one, there must be some modifying factor or factors at work which influence the production of the hulled or naked type. Fig. 13 shows the parent forms and F_1 types of some hulled and hull-less crosses.

Studies on awn inheritance show that for the weak awn the fully awned condition is recessive and the character seems to follow a simple 1:2:1 ratio. The liguleless types have been crossed with a number of ligule bearing forms. So far the studies have shown that the presence of ligule was represented by 1 and 2 factors in the different sorts. A number of linkages have been found to exist in oats as evidenced by a number of the crosses studies.

In the hybridization work with wheat crosses have been made between the different cultivated forms as well as between the different wheat species. The cultivated forms have also been crossed with the various species and with the wild form, T. hermonis.[4] Such characters as color of chaff, color of kernel,

[4] The name suggested by O. F. Cook, Bulletin 274, B. P. S.



INDIVIDUAL SPIKELETS OF THE HYBRID OAT

Parent types and F_1 of two crosses of the hull-less oat. 595Y is the hulled parent and 595a is the F_1 hybrid. 379y is *Avena fatua* and 379a is the F_1 hybrid. (Fig. 13.)

1256X 1256a 1256y

CROSSING OF WHEAT AND EMMER

Parent types and F_1 of a cross between common wheat and emmer. 1256a is the F_1 hybrid. Emmer, shown on right, is a grain little grown in America, but much used in Russia. It has heads with very long stiff bristles, and is in other respects different from wheat. It is hardy and drouth resistant. The successful crossing of emmer with common wheat (on left) and the production of a true hybrid between the two may lead through selection to results of importance to agriculture. (Fig. 14.)

A HYBRID BETWEEN DURUM AND COMMON WHEAT

The hybrid head shown between the durum wheat head with long bristles on the right and the almost awnless on left appears intermediate in character. 2030a is the F_1 hybrid. (Fig. 15.)

awning, pubescense of the glume, compactness and the like, are being observed. The red color of kernel is found to be represented in different sorts by one, two or more factors, as has been found by others.

The crosses between the different species are furnishing much of interest regarding the nature of the inheritance of the various characters as well as some information regarding the possible origin of some of the types. Fig. 14 shows the parents and F_1 type of a cross between emmer and common wheat. A cross between *T. durum* and *T. vulgare* furnished two plants in the second generation which closely resembled the wild wheat or emmer, T. hermonis. Fig. 15 shows the parents and F_1 type of the cross which in the second generation produced these two wild forms. These forms have been grown through the fourth generation and have given many forms possessing the articulation of this wild type.

Two fertile hybrids have been found between wheat and rye and one of these has been carried through the fourth generation and is now being tested as to its winter hardiness. After the second generation most of the types have been wheat-like in appearance, yet the kernels show some modification.

The Place of Intelligence in Evolution

CELL INTELLIGENCE THE CAUSE OF EVOLUTION, by Nels Quevli. Pp. 460, with 53 illustrations. Price $1.58 postpaid. Standard Book Co., Mason City, Iowa.

When a battleship is built and operated, the intelligence of some man is given credit. The growth of the human body from a single cell, and the subsequent functioning of that body, are more remarkable occurrences; why not attribute them to the intelligence of the cell? Mr. Quevli argues at great length that the cell *is* a conscious, intelligent being, and by reason thereof plans and builds all plants and animals in the same manner that man constructs houses, railways, and other structures. In cell intelligence he finds the cause of both heredity and development.

This is a perfectly logical position to take. Why is it, then, that men of science are so seldom satisfied with it? Because it leads to nowhere. Mr. Quevli may be right in thinking that all the acts of the cell are due to the possession of intelligence; but once they are explained by the term there is little more to be said. The case is settled. Science, however, cannot remain satisfied with such a solution; it progresses only as the sequences of events in which the cell is concerned are observed and described. It has been found from abundant experience that research of this kind is most profitably carried on when all thought of intelligence is left behind, and the cell's activities are studied as manifestations of the properties of matter.

In his preface Mr. Quevli expresses the suspicion that his book will arouse the hostility of men of science "who may think they will be injured in their business." There is some truth in this though not at all in the way Mr. Quevli imagines. Mr. Quevli may be right and the orthodox biologists wrong, in their respective views of evolution. But the adoption of Mr. Quevli's view *would* interfere with the business of men of science. It would be a hindrance to research. They will, therefore, continue to deal with cells without ascribing any intelligence to them. For the purpose of research, science must be mechanistic. But at the same time, it is well to remember that the mechanistic view sees only one side of evolution. From a philosophical point of view, it is quite possible that the whole universe might be interpreted in terms of intelligence just as well as in terms of physics and chemistry.

HEREDITY AND DISEASE

Influence of Heredity Heretofore Largely Overlooked—Both Favorable and Unfavorable Characteristics Subject to the Same Laws—Lessened Resistance Probably Heritable

CHARLES HERRMAN, M.D.

Attending Pediatrist to the Lebanon Hospital, New York

IT HAS always been a matter of surprise to me, that physicians have given so little attention to heredity as a factor in the causation of disease. Pediatrists especially should be interested, for many inherited qualities and characteristics, show themselves at birth, or in early infancy, and at that time the analysis is still simple. In later life, other factors, such as previous disease, alcoholism, worry and imitation are added, and the problem becomes more complicated.

As a matter of convenience we usually distinguish between the inheritance of favorable and unfavorable qualities or characteristics; but both are subject to the same laws. The eugenist is primarily interested in the former, the physician chiefly in the latter. We frequently separate the inheritance of anthropological, pathological and psychical characteristics; but they, too, should not be separated. It is a curious fact, that although physicians and laymen recognize the inheritance of anthropological peculiarities, the inheritance of pathological and psychical anomalies is almost completely ignored. One constantly hears, that a child has his mother's eyes or his grandfather's nose; but if a child is born with a hare lip, one is apt to hear, that the mother was frightened by a rabbit during pregnancy; or if the child is born with a defective development of the brain, that the mother had a great deal of worry during pregnancy, or that the attending physician did not conduct the labor skillfully. That the inheritance of anthropological, psychical, and pathological characteristics, are closely related is shown by the fact, that all three, may be represented in an anomalous form in the same patient. Take for example, the mongolian imbecile; the brachycephalic head, with the flattened occiput, the downward and inward slant of the eyes, and the flattened bridge of the nose, are anthropological peculiarities; the defective intelligence, the psychical; and the frequent presence of such congenital anomalies, as polydactylism, syndactilism and congenital heart disease, the pathological peculiarities.

LESSENED RESISTANCE HERITABLE

If we believe, that such anthropological, psychical and pathological characteristics, may be on a hereditary basis, why may we not go a step further, and admit the possible inheritance of a lessened resistance of certain organs, or parts of the body? I have reported (Archives of Pediatrics, March, 1916) the history of a family in which six children died of pulmonary disease, shortly after birth, or in early infancy. I have also had under observation a family, in which five children had heart disease of the same type. These of course represent unusual and striking examples, of a vulnerability of a certain organ; but every physician can cite less marked examples of such a family predisposition, from his own practice.

In the etiology of disease, physicians have always recognized two factors; the character and virulence of the infectious material; and the susceptibility or resistance of the individual infected. As a rule, however, the importance of the former, has been overestimated, and that of the latter underestimated, possibly because it is more difficult to detect and appraise. Still

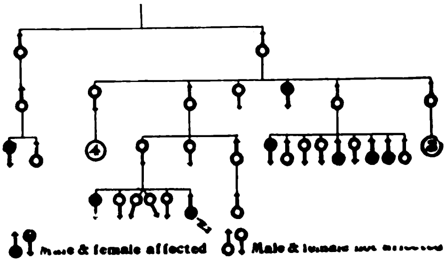
there is abundant proof of differences in susceptibility in different families, and in different members in the same family. It has been noted (Park and Zingher) that when the youngest member of the family gives a negative Schick reaction, on the introduction of diphtheria toxin, the rest of the members of that family, will also give a negative reaction, showing that they are all immune to a diphtheritic infection. As an illustration of a difference in susceptibility or resistance in children of the same family, I may cite a recent experience. In a family in which there were three children, the oldest, who was five years of age was attacked with measles. He infected the other two children, two years, and eight months of age respectively. The younger had an extremely mild attack of the disease, as infants under 9 months usually do; but the older had an extremely severe attack with complications, and died.

Years ago, the French school especially laid great stress on the so-called diatheses. They were, of course, very much overdone; but now the pendulum has swung a little too far in the other direction, and the diatheses have been very largely discarded as factors in the causation of disease. A similar change has taken place in the use of venesection. At one time, practically all ailments were treated by blood letting, and probably in some cases very great injury was done; but now, it is often not done in cases in which it might be life saving. I believe all pediatrists will admit that there are two diatheses, namely, the so-called exudative, and the spasmophilic, diatheses.

PATHOLOGIC SYMPTOMS OFTEN SOUGHT

In the etiology of diseases not distinctly of microbial origin, tuberculosis, syphilis, and alcoholism, are constantly sought. These conditions do undoubtedly often play an important part; but since the introduction of the Wassermann reaction, the rôle of syphilis has certainly attracted too much attention. Everyone admits that the etiological importance of syphilis was formerly frequently overlooked or unrecognized; but now its importance is surely overestimated, especially in conditions which are inherited. Recently Holt reported that in fifty-six children with various congenital anomalies, the Wassermann reaction was negative in every case.

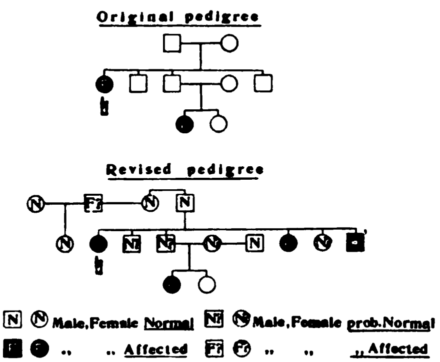
When no other plausible explanation of a congenital disease is obtainable, *toxemia*, during pregnancy, is a favorite solution of the difficulty. As an illustration, take amaurotic family idiocy. Hirsch believed that it was due to some toxic substance in the mother's milk. But the disease has occurred in infants who were artificially fed; the same mother may give the breast in turn to several children, and some will develop the disease while others will remain normal. That the disease is not due to any disease or toxemia of the mother during pregnancy, is shown by the fact that the mother may have alternately a normal and an abnormal child. (Fig. 16.). I have reported (Archives of Pediatrics, December, 1915) a case of amaurotic family idiocy in one of twins, the other child developing in a perfectly normal manner. It is very difficult to conceive of any form of toxemia in the mother that would affect only one of twins. The two children were fed in exactly the same way; they lived in exactly the same surroundings. On a hereditary basis it is not difficult to explain this difference. It is a well-recognized fact that the two ova are distinct, and that twins may be unlike in very many respects.



AMAUROTIC FAMILY IDIOCY

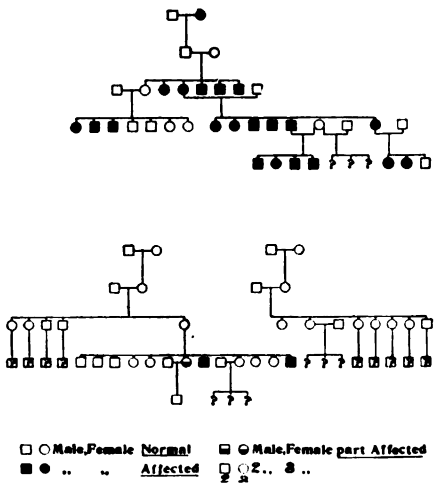
The above chart shows the ancestry of a case of amaurotic family idiocy from Falkenheim. The hand points to the patient. The numerals in circles represent number of children whose sex was unknown. (Fig. 16.)

Why is it that so little attention has been given to heredity as a possible factor in the causation of disease? In the majority of cases the connection is not so striking as to be immediately apparent. Our family histories and pedigrees are very inaccurate and incomplete. Many physicians content themselves with an inquiry as to the health of the parents and the brothers and sisters of the patient. The facts are not on the surface; they have to be dug out. If the unit character is recessive, it may show itself in only a very small number of the entire family, in several generations, and this character may not always show itself in exactly the same form. It is often extremely difficult to get a complete family history, first, on account of lack of knowledge on the part of the parents. Very few individuals can give a complete account of the members of both branches of the family. For this reason, several members of the family should be interviewed. Secondly, there is often a desire to conceal unfavorable qualities or tendencies, such, for example, as insanity or mental defectiveness, and only with the greatest tact can such information be obtained. Compare, in Fig. 17, an original and a revised pedigree as given by Goddard. Thirdly, the children who present the



MONGOLIAN IMBECILITY

Two charts by Goddard are shown above, the first the original and the second the revised form, which was drafted when additional information could be secured. It may immediately be seen that erroneous conclusions might be based on the original chart. (Fig. 17.)



PEDIGREES OF POLYDACTYLISM[1]

That polydactylism is an inherited unit character might be attested by the first pedigree above, but the second chart, containing only three isolated cases, shows the greatest difference. There is undoubtedly a great need for additional statistics to establish its status definitely. (Fig. 18.)

anomaly are frequently among the miscarriages, stillbirths, or those dying in early infancy, and such cases may be easily overlooked. For example, an amaurotic family idiot may appear normal during the first five months, so that if such an infant died before that time, the presence of the disease would not be suspected. As has been stated, if the unit character is recessive, it may be noted in only a few individuals in several generations; however, even in the case of a unit character, which is usually considered as dominant, a great variation in the number of individuals affected may occur. Fig. 18 presents the pedigrees of two families in which polydactylism occurred. The first is that reported by Smith and Norwell (*Brit. Med. Jour.*, 1894, Vol. ii, p. 8), the second by Struthers (*Edinburgh New Phil. Jour.*, 1863, Vol. xviii, p. 83). This is an anomaly which would hardly be likely to escape notice, even in a child that died in early infancy; there would be no reason for concealing the facts, and still the two charts show the greatest difference in the number of individuals affected.

[1] The first is that reported by Smith and Norwell (*British Medical Journal*, 1894, Vol. ii, p. 8), the second by Struthers (*Edinburgh New Philadelphia Journal*, 1863, Vol. xxviii, p. 83).

It is absolutely necessary to get a complete history. I recently saw a child with sporadic cretinism. In answer to the usual questions, the mother stated that no other members in either branch of the family were similarly affected, and as far as she knew all the children began to talk and walk at the usual time. However, on further questioning it was found that two of the father's sisters had been operated upon for goiter and an older brother of the patient, who was 16 years of age, weighed 225 pounds. Here, at least, there was an indication of a family tendency to disturbances in the thyroid gland and the endocrine system. If a number of physicians, engaged in the different specialties, would collect a large number of complete pedigrees in those diseases and conditions which are known to be frequently inherited, I believe a large amount of valuable data can be obtained, and much light could be thrown on many of the obscure problems of etiology.

Influence of Environment on Tree Growth

When I bought my property here there existed upon it a certain number of "blue gum" trees (*Eucalyptus globulus*) all planted at the same time, in 1880, and of different degrees of development, according to their position (on natural unbroken soil, on loose deposits of "made" soil, and in more or less sheltered places).

One of them, now, like the others, 37 years old, has a circumference of 8½ cm. at the height of 1 m. It was planted in close proximity to a dense, wild vegetation of evergreen and deciduous oaks and other trees and on the upper edge of the slope, where these trees grow. The other blue gums are of very unequal development according to their position, and some of them, those planted in soil brought on and consequently loose to a great depth, are what I should take to be normal in size, when growing in a dry climate and receiving no irrigation.

But I have planted a few blue gums myself, and one of them, planted in hard soil, never broken except for the small hole in which the seedling was planted, is now 22½ years old and measures 2½ meters in circumference, at one meter height above the ground. The secret of the great development of this specimen is that water is running nearly always at the foot of this tree.

Everybody can assure himself of the enormous difference in development of annual plants (so easy to control), according to more or less favorable conditions, but when it is a question of wild-growing trees, facts are not always so prominent as to attract attention. Plants of whatever kind will often continue to live under most unfavorable conditions but making hardly any growth; and even species famous for extraordinarily rapid development as the blue gums will accommodate themselves to such a state. The quickest growing palms of temperate climates, the Washingtonias (California fan-palms), furnish another example in my garden, where a certain number planted on the edge of a slope covered with native tree vegetation have remained stationary, the size of two year old seedlings, for sixteen years.

It seems very necessary to distinguish between the development of a tree in highly favorable conditions, as the arbor vitae shown in the picture growing in a park (p. 161, JOURNAL OF HEREDITY, April, 1917) and wild trees usually growing in crowded condition and having to compete for light and root space with numerous others. Only such live in what I should call "normal" conditions, because so uninfluenced by man. The most perfect development of a plant can only take place in quite exceptional conditions in the wild state, elsewhere it must be sought for where man has stepped in to favor the plant in question.

A. ROBERTSON PROSCHOWSKY,
Parc "Les Tropiques,"
Nice, France.

CHRYSANTHEMUM VARIETIES

Many Have Arisen from Bud Variations—List of Four Hundred Varieties Originating from Bud Sports Compiled—Plant Has Been Cultivated for Hundreds of Years

A. D. SHAMEL, *Riverside, Calif.*

THE Chrysanthemum is one of the garden plants in which the greatest number of bud variations has been observed. According to Prof. J. S. Cramer,[1] a great part of the present cultivated varieties originated in this way. A list of about four hundred varieties of chrysanthemums originating from bud sports has been collected by Professor Cramer. A few of these varieties, the approximate date of their origin, the parent variety, and the published authority, are shown in the following table:

Parent variety	Bud sport variety	Published authority[2]
Alcester (Lord), 1882, from Empress of India. Inflected, butter-yellow.	John Lambert, 1886. Inflected, cream white with pink tinge.	G. C. 89, II, 733 T. G. 89, I, 92 T. G. 90, I, 279
Alcester (Lord), 1882, from Empress of India: Inflected, butter-yellow.	Mr. Robert Mudie, 1888 (John Doughty). Inflected, salmon pink.	T. G. 90, I, 145
Alfred (Prince), 1863. Inflected, violet red.	Lord Wolseley, 1883. Inflected.	T. G. 89, I, 123 G. C. 82, II, 659
Amsden (Ethel), Japanese. Green Viviand Morel.	Small white tufts. Form like that of Viv. Morel.	G. C. 94, II, 700
Anderson (Marie), Single. Light red.	Miss A. Holden, 1895, yellow.	T. G. 96, I, 130
Argentine. Small white pompon.	Large yellow loose flower clusters.	Pr. et fix, p. 34
Audiguier (Edward), 1886, Jap. Brown, purple, silver back.	Mrs. William Walters, 1887, Jap. Carmine, bronze-gold back.	T. G. 88, II, 498.
Aurore boreale. Pomp., brown-yellow.	Golden Aurore. Pomp., gold-yellow.	d. M., I, 34
Australia. Inflected, gold yellow.	Madame Heerewege, 1900. Drooping flowers. Center white, tufts yellow or pink.	G. C. 01, II, 343 G. C. 02, I, 51
Automne (L') 1887, Jap. Inflected, salmon-red.	Mademoiselle Marie Mawet, 1890, Jap. Orange gold.	d. M., I, 62
Avalanche, 1887, Jap. Snow white.	Edw. Beckett, 1892, Jap. Dark gold-yellow.	d. M., I, 8
Baco (Madame), 1886, Jap. Silvery pink.	Mrs. A. Jacobs, 1893, Jap. Dull pink.	d. M., II, 49

[1] Cramer, Prof. J. S., 1907. Kritische Uebersucht der bekannten Fëlle von Knospenvariation.
[2] The periodicals are indicated by their initials: G. C. is *Gardener's Chronicle;* J.R.H.S., is *Journal of the Royal Horticultural Society;* d. M., a published list by De Meulenaese; T. G., *The Garden.*

Parent variety	Bud sport variety	Published authority
Barbara, 1869. Inflected, clear amber yellow.	Clear yellow, small flowered. Barbara, 1869. Inflected, somewhat like the preceding but outer floral leaves bronze.	d. M., I, 68 Bueb., p. 92
Barbara, 1869. Inflected, clear amber yellow.	A chocolate brown bud variation which did not become fixed.	T. G. 67, I, 269
Barclay (Mrs.), Jap.	Lady Cranston. White suggestion of color.	T. G. 03, II, 448
Beatrice (Princess), 1868. Inflected, rose.	Mr. Walter Butters. Inflected, red brown with amber yellow. G. Cockburn, 1892. Inflected, gold bronze.	d. M., I, 72 G. C. 93, II, 567
Belocca (Armade). Inflected, sulphur yellow and white.	Miss Jennie (-Jeannie). Inflected, pure yellow.	d. M., I, 68 Burb., 121
Bernard M., 1886, Jap. Dark violet.	Mrs. Charles Cox, 1893, Jap. Carmine mixed with bronze.	T. G. 93, II, 386
Beverley Imported, 1863. Inflected, cream white.	Red striped flowers, too constant for a variety.	T. G. 89, I, 69
Beverley imported, 1863. Inflected, cream white.	Golden Beverley, 1866. Inflected, pale yellow.	G. C. 75, II, 686 G. C. 93, II, 567
Beverley (golden), 1866. Inflected, pale yellow.	Mr. Bunn, 1881. Inflected. Better formed. Darker yellow.	T. G. 89, I, 40
Beverley (golden), 1866. Inflected, pale yellow.	H. Shoesmith, 1888. Inflected, bronze.	T. G. 89, I, 69 G. C. 93, II, 567
Bird (Lillian B.), 1889. Imported from Japan.	Leon Chandon. Jap. Violet-pink.	D. M., II, 19
Bird (Lillian B.), 1889. Imported from Japan.	Mrs. J. T. Tibbs. Jap. White.	T. G. 98, II, 469
Bismarck, 1870. Jap. Orange.	O. Kiku, Jap. Leather yellow.	d. M., I, 85
Blushing Bride. Pompon pink.	Bronze Bride. Pompon bronze.	T. G. 96, II, 185
Boadica. Inflected, violet red, with yellow tips.	Hilda. Inflected. Flowers lavender blue with yellow tips. Center of flower head pale yellow.	G. C. 78, I, 18
Boehmer (Louis), 1890, Jap. Hairy. Silvery pink.	William Falconer, 1892. Same form. Delicate rose.	T. G. 94, I, 184 T. G. 92, I, 487
Boehmer (Louis), 1890, Jap. Hairy. Silvery pink.	Improved Louis Boehmer, Jap. Inflected. Hairy. Red.	d. M., II, 11.
Boehmer (Louis), 1890, Jap. Hairy. Silvery pink.	Enfant des deux Mondes, 1893. Same form. White.	T. G. 94, I, 184 Barber L. C., 178
Boehmer (Louis), 1890, Jap. Hairy. Silvery pink.	Doctor Allard, 1894. Carmine red. Back golden.	d. M., II, 2
Boehmer (Louis), 1890, Jap. Hairy. Silvery pink.	Deuil de Jules Ferry, 1894. Dark violet. Back light.	d. M., II, 35
Borel (President), 1892, Japan. Replicate. Purple. Silver back.	Eastmann Belle, 1899. Deep red, gold back.	T. G. 99, II, 488 G. C. 00, I, 132

Parent variety	Bud sport variety	Published authority
Boule d'or, 1892, Jap. Golden-yellow. Bronze.	Chestnut brown.	G. C. 91, I, 213
Bouquet fait, 1800. M. Planchenau, Jap. Silver pink. Gold center.	William Robinson, 1884. Light orange yellow.	T. G. 88, II, 530 T. G. 89, I, 331
Bouquet fait, 1800. M. Planchenau, Jap. Silver pink. Gold center.	Mary Louisa Galton. Paler than Bouquet fait. Blooms very early.	T. G. 89, I, 331
Bouquet fait, 1800. M. Planchenau, Jap. Silver pink. Gold center.	Miss Gorton, 1887. Cream white, pink.	G. C. 89, I, 40.
Brooke (Lord), 1891, Jap. Inflected, orange bronze.	Mrs. John Cooper. Carmine red.	T. G. 97, I, 95.
Brocklebank (Ralph), 1886, Jap. Deep primula yellow.	Mrs. Bevan Edwards, 1887. Light golden yellow.	T. G. 88, II, 487, 498 T. G. 89, I, 259

HAS LONG BEEN CULTIVATED

According to Cramer the chrysanthemum has been cultivated for some hundreds of years. A sketch of its history has been published by Helmsley under the title of "History of the Chrysanthemum" in Gardener's Chronicle 1889, II, p. 521, p. 555, p. 585, p. 652. Its culture in Europe dates from 1688, when Bruyne found chrysanthemums in Dutch gardens. In 1822, twenty-seven varieties were cultivated in England, part of which had been imported, and some of which had originated from the imported varieties through bud variations. Later the production of new varieties was undertaken from seed and by the careful selection of bud variations. In 1836 there were imported three Chinese varieties with pink, speckled, and flesh-colored flowers respectively. The next year a single plant bore all three of these varieties.

One of the most prolific sources of new and beautiful varieties of chrysanthemums has been Japan. In 1892 there existed 269 varieties in Japan and new ones have been produced yearly for export to Europe and elsewhere.

European gardeners have produced an enormous number of varieties. In 1890 there were 300 cultivated varieties, and in 1899 about 8,800. While there was undoubtedly some duplication in varietal names, some varieties were probably not announced at all because of their apparent relationship to existing varieties.

EASY TO PROPAGATE

The chrysanthemum is easy to propagate by cuttings which probably accounts for the large number of varieties produced vegetatively. Owing to the fact that the flowers are often of different color on opening than at a later stage, and that color changes are frequently brought about as a result of conditions of nourishment, only those variations that remain constant under changed cultural conditions should be considered to be true bud variations. If the variations can be propagated successfully they may be considered to be bud sports and incipient new varieties.

The bud variations which attract attention are usually those which affect the bloom. The variations of vegetative parts are as common as bloom variations but owing to their inconspicuousness are not usually observed by growers. Variegated leaf varieties; *e.g.*, Queen of England (*Gardeners' Chronicle*, 1863, p. 1107) is an example of this kind of bud variation.

Bud variations in chrysanthemums, according to Cramer, occasionally show so complete a change of form as to put

the new plant in another class. For example, the reflexed carmine, King of Crimsons, produced vegetatively the carmine anemone variety, Mrs. R. A. Mudie; from the reflexed white Christine Caine, the incurved white John Bradner. Flowers of one color become striped, as, from the red Queen of England came the striped Queen of England.

Some varieties are not known to have ever produced bud variations; *e.g.*, Nonpareil, which has been grown for sixty years.

According to Elmer D. Smith & Co.,[3] of Adrian, Mich., "Regarding bud variation there seems to be no law to be depended upon, it is so obscure. We know of some which sport with only a few petals and will vary only a very little, and again, they will sport an entirely different color. We have grown some varieties and they will be true to type for a number of years and then will sport another color in several places in one season, some distance apart."

DIFFERENT COLORS ON SAME PLANT

In October, 1917, the writer's attention was called to a plant grown by H. E. Witte, 439 Chestnut Street, Riverside, California, bearing two varieties of chrysanthemums. The plant consisted of a short stem, having two nearly equal branches, each bearing different colored flowers of about the same size. The name of the parent variety is unknown to Mr. Witte. It has been grown by him for three years and bears pink colored flowers. The bud variation, on the sporting plant, bore a yellow colored blossom. The two blossoms retained their color virtually unimpaired from the beginning to the end of the blooming period. The two branches bearing the different colored blossoms arose from adjoining buds near the base of the stem. The difference in color of the two blossoms was very striking and attracted the attention of many observers. There is no doubt but that it is an example of the rather frequent occurrence of bud variation in the cultivated chrysanthemums.

The writer, in his garden at Riverside, grew three beds of chrysanthemums in 1917. A careful inspection of the plants all of which were propagated from cuttings, revealed several instances of different colored flowers borne by the same plant, and of different colored petals in the same blossom. While variation in leaf shape and arrangement were observed in some of these plants, a lack of knowledge of plant characteristics prevented any careful or intelligent consideration of these variations at this time. The writer, however, is planning to study his chrysanthemum plants more carefully from the bud variation standpoint the coming season. It seems to be one of the most interesting of cultivated flowering plants upon which to base a systematic study of bud variability.

The foregoing discussion is presented for the purpose of calling attention to the origin of valuable cultivated varieties of ornamental plants from bud variations.

Ohio Conserving Superior Seed Corn

In order to locate all good seed corn, the Ohio Experiment Station at Wooster is offering to test corn free for any Ohio farmer. Seed corn in Ohio in 1917 is considered poorer than it has been for many years, and for this reason, steps are being taken to insure a normal crop this year. Samples of one hundred kernels chosen from one hundred representative ears may be sent in by any farmer, together with the name of the variety, how the seed was chosen and stored, and a statement regarding the quantity of corn like the sample he may have to sell. By this method, it is hoped that all available seed of real worth may be located, superior seed be assured for this season, and the buyer and seller may later be brought together.

[3] Letter of November 24, 1917.

A STRIKING REPRODUCTIVE HABIT

Albert A. Hansen
U. S. Department of Agriculture, Washington, D. C.

IT HAS long been recognized that external factors largely influence variation in the reproductive organs of plants, especially influencing vegetative methods of reproduction.

Data concerning such influences, especially as to just what the external factors are and to what extent such influences are felt, are as yet largely unaccumulated.

Without attempting to explain the phenomenon illustrated in the accompanying picture (Fig. 23), the mere facts of the case will be presented.

The plant, an Easter lily, *Lilium longiflorum*, var. *eximium*, was cast under the greenhouse bench into a dark situation immediately after the flowering stage was terminated. The environment was warm and dry. In a short time the main axis of the plant developed the interesting set of bulb-like structures noted in the illustration.

In order to ascertain if the character was hereditary, the "bulbs" were removed and planted. They grew readily, forming perfectly normal plants, devoid of the unusual "bulbs" possessed by the parent. The experiment was carried no further. The phenomenon was probably due to existing external conditions rather than to inherent or internal causes.

In this connection, however, it should be remembered that the Easter lily is one of a group of plants many members of which are noted for their bulb producing propensities, such as the onion, *Allium sepium*, and for bulbil producing tendencies, as the wild garlic, *Allium canadense*, and the tiger lily, *Lilium tigrinum*. In the case of the latter, numerous bulbils are formed along the stem, somewhat similar to the "bulbs" noted in the Easter lily. Each axil of the sessile foliage leaves of the tiger lily may form a bulbil and each bulbil may fall to the ground and form a new plant.

The situation in the wild garlic is particularly interesting; here flowers and bulbils are formed promiscuously on the same head.

The bulb-like structures formed on the Easter lily may have been due to the formation of adventitious buds or to the enlarging of dormant buds, though the structures were rather large to be classified as buds.

In general, it might be said that dry conditions are inclined to favor the production of specialized organs such as the lily "bulbs" here considered, though, of course, there are many exceptions to this statement. This interesting plant was found in the botanical greenhouse of the Pennsylvania State College.

Decline of Birth Rate in Hungary

Although many warring nations have ceased to publish their vital statistics, Hungary is still making regular returns. A Budapest newspaper is quoted as saying that in February, 1917, the number of deaths in Hungary exceeded by 13,000 the number of births. Among civilians alone, it is stated that in the third year of the war the number of deaths exceeded the number of births by 130,000. Hungarian vital statistics have in the past had an excellent reputation for accuracy, but newspaper reports at present must naturally be taken with caution, until properly substantiated.

AN ODD FORM OF REPRODUCTION

The Easter Lily plant here illustrated was cast under a greenhouse bench immediately after flowering. In a few days the odd bulb-like structures developed upon the main stem. The bulbs were planted, forming offspring readily. The phenomenon was not heritable. (Fig. 19.)

COLOR INHERITANCE IN MAMMALS

IX, The Dog—Many Kinds of White Patterns Found—Albinism Resembles That of Other Mammals in Reducing Red More Than Black—Inheritance of Black-and-Tan Requires Further Data—Red and Liver Simple Recessives

SEWALL WRIGHT
Bureau of Animal Industry, Washington, D. C.

SOLID BLACK DOG—tvCEB

$1a_1$	R,r	R—roan
$1a_2$	V,v	V—piebald (unit factor uncertain)
$1a_3$	—	
1b	C,c	c—imperfect albino (slate-brown coat, blue iris, red pupil)
$2a_1$	—	
$2a_2$	—	
$2a_3$	E,e	e—red (eyes unaffected)
2b	B,b	b—liver (brown coat, skin and eyes)

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

THERE are many kinds of white patterns in dogs. There are the common, irregular, piebalds of many breeds; the black eyed whites, such as in Bulldogs; the roans occasionally found among Cocker Spaniels; the spotted Dalmation Coach Dogs; the albinotic Pekinese Spaniels, etc. Barrows and Phillips[1] find that the blue roans and red roans, in Cocker Spaniels, differ from blacks and reds respectively, by a single dominant factor. They also find the piebald pattern to be dominant. Much more work is necessary, however, before the great variations in extent and pattern in piebald dogs may be considered to be understood. Most black eyed whites, as Castle[2] has suggested, are probably comparable to the black eyed white guinea-pigs and mice in possessing an extreme form of the piebald pattern.

Dogs, with a very irregular, a symmetrical type of piebald pattern, are often wall-eyed according to Pearson, Nettleship and Usher.[3] Among other breeds they mention in this connection, the Old English Sheep Dog, the Dappled Dachs and the Harlequin Great Dane. The Merled Collies, which they also mention, probably belong in a different category. In them, it does not appear to be an irregular piebald pattern, which has invaded the eye; but a general dilution factor, which reduces red to white, and black to slate blue, affecting the eyes as well as the coat. The piebald pattern may also invade the inner ear, and in some way bring about deafness. Thus Pearson, Nettleship and Usher mention deafness as common among white Bull and Fox Terriers, which are extreme piebalds, but note its absence in whites of several other breeds including Collies and Pekinese Spaniels, where a dilution factor is responsible for the whiteness. This deafness in white dogs, calls to mind the deafness of blue-eyed white cats which was noted by Darwin.

A white, with dark points, is occasionally found among Cocker Spaniels. Barrows and Phillips[4] find that this is due to a recessive factor, which reduces red to white, but black merely to a slate blue. Whether it also affects the eye, they do not mention. These authors speak of another kind of dilution in Cockers, which they have not tried to analyze. Thus, livers vary from dark

[1] Barrows, W. M. and J. N. Phillips, 1915. JOURNAL HEREDITY, 6:387-397.
[2] Castle, W. E., Genetics and Eugenics, pp. 138-140.
[3] Pearson, K., E. Nettleship and C. H. Usher, 1913. A monograph on albinism in man. Part II, pp. 460-512.
[4] Barrows, W. M. and J. N. Phillips. *Loc. cit.*

chestnut to a faded liver color, and reds vary from mahogany to lemon. The case of blue Merled Collies has been noted above. The kind of dilution, which has been most thoroughly investigated, is that of the imperfect albinos, which occasionally appear in Pekinese Spaniels. Pearson, Nettleship and Usher describe extensive experiments with them.

ALBINO PEKINESE SPANIELS

Their albinos came from a stock of red Pekinese. Most of them were not complete albinos, but were slightly tinted with cream color. The skin was pink, the iris pale blue, and the pupil red in some lights. The coat was often distinctly colored, in the puppies, with a dull brown color, which might show a distinct piebald pattern. Granular pigment was present in these puppies, but in the adults only traces of diffuse pigment could be found, as a rule. This change in color is parallel to a change in the normal red Pekinese Spaniels, whose coats are brown, tipped with black, as puppies, but turn red later, only the face and scattered hairs on the back retaining the dark color. The mode of inheritance seems clearly that of a single recessive factor. The authors are disposed to question any Mendelian interpretation, but this is largely because they consider the piebald pattern, which appeared irregularly through their experiments, as connected with albinism, and because of complications, due to the introduction into the experiments of a second well known Mendelian factor: that in which blacks are dominant over reds.

Although coming from a colored stock, the albinos bred true at once, (except for minor variations). Albino by albino produced 66 albinos, of which 11 were decidedly brown as puppies, and 2 were recognizable piebalds. Red parents, both of which were known to carry albinism, from knowledge of their parents or offspring, produced 32 red, and 14 albino puppies, about as expected, allowing for matings of their type which were unrecognized because no albinos were produced. Red by albino produced only 57 reds in 16 litters, and 5 reds, 4 albinos in 2 other litters. Most of the reds were evidently homozygous. Some of the albino Pekinese were crossed with black Pomeranians. As these albinos came from red stock, this cross would be expected to involve at least two Mendelian factors; that by which blacks differ from reds, and that by which intense colored dogs differ from albinos. In F_1 all of the puppies were intense, and most of them black. Two of the 17 were called chocolate, which indicates that the Pomeranians were not all homozygous black. Some of the black offspring (EeCc) were crossed together and produced 6 blacks (with white patches), 1 red sable, like a normal Pekinese, 1 normal albino and 1 permanently slate-brown or "lilac" puppy, with the eyes of an albino. One need have little hesitation is surmising that this "lilac" is the albino form of black (Ecc) where the usual Pekinese albino is the albino form of red (eecc). A back cross of F_1 black with Pekinese albino likewise produced the four expected classes. There were 10 blacks, 2 golden sables, 1 "lilac," and 2 usual albinos (one of which showed a red streak on its back). The ratio, it is true, is very aberrant; such a large excess of blacks should be produced only once in a thousand times, but taking the evidence as a whole, there seems little reason for doubting that merely two unit Mendelian factors are involved aside from the factor or factors for the piebald pattern. It has been suggested above that the albino factor which reduces red to white merely reduces black to slate-brown. This is in harmony with the brown color of Pekinese albinos at the time of life in which normal reds show much black pigment. It is also thoroughly in harmony with the effects of imperfect albinism in other mammals. The same difference in the threshholds for black and red, with respect to albinism, have been noted in previous papers in the discussion of red-eyed dilute guinea-pigs and rats, and Himalayan rabbits. A similar phenomenon is found in man.

Among factors of class 2, it seems well established that all grades of red differ

from black and liver by a recessive unit factor. Little[5] obtained satisfactory figures demonstrating this point in Pointers, and Barrows and Phillips[6] confirm it in Cocker Spaniels. The presence of this factor difference between red Pekinese and black Pomeranians has just been noted.

This, however, leaves uncertain the genetic relations of the various kinds of mixtures of black and yellow. The common color of Collies is a sort of sooty yellow; in Great Danes, Bull Terriers and other breeds there is a brindle pattern and many breeds are characterized by the black-and-tan pattern in which the feet, belly, and parts of the head are tan or yellow, the rest of the coat being black. A similar pattern is found among the wild canidae.

THE TRICOLOR PATTERN

In many breeds both the piebald and the black-and-tan pattern are present together. The result is a tricolor. The mode of inheritance of tricolor is of special interest because it was the character in Bassett hounds, which was chosen by Galton[7] in his pioneer investigations of the laws of heredity. The tricolor Bassett hounds continually throw bicolor lemon and white, and vice versa.

Galton demonstrated heredity in this case, and showed that his law of ancestral heredity would fit the results satisfactorily. This law claims only to describe the average results in a dog population mated at random as regards color and is not intended to apply to particular cases. As Castle[8] has pointed out, no simple Mendelian ratios are to be expected in this case, in which the occurrence of bicolors depends on the arrangement of two independent, fluctuating patterns. Castle compared the case with that of tricolor guinea-pigs, which result from the combination of the piebald and tortoise shell patterns, with genetic results as confusing to follow as the Bassett hounds. Hagedoorn[9] pointed out that the black-and-tan pattern in dogs is a more symmetrical pattern than the tortoise of guinea-pigs, but in the main accepted Castle's view. Ibsen[10] pointed out that Bassetts have a reduced type of the black-and-tan pattern, like that of Airedales, in which there is only a blanket of black on the back, leaving the head yellow. As the white of the piebald pattern affects the back before the head, lemon and white is more apt to be produced than black and white on reduction in the number of colored spots. It is clear that the mode of inheritance of tricolor can best be solved by studying the heredity of the piebald and the black-and-tan patterns separately.

Barrows and Phillips[11] identify the pattern of black-and-tans with that of liver-and-tans, and of red-and-lemons. They state that a recessive factor is responsible for the production of these "bicolors" from blacks, livers, and reds respectively. A priori the indentification of the patterns of black-and-tans and liver-and-tans, seems probable enough, but red-and-tan seems to involve a different kind of factor. The first two involve variations in extension of a dark color, and therefore involve factors of class 2 while the last is a pattern of intensity which would seem to fall in class 1.

It has been noted that in the rodents and in cats there is a tendency for the processes of producing color in general (involving enzyme 1) and of producing black (involving enzyme II) to be weak in the same parts of the coat. Thus the patterns of intensity of color (particularly of yellow) and of extension of black, tend to be similar, although brought out by wholly independent Mendelian factors. For example yellow-bellied gray mice differ from solid grays for a wholly different reason from that

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[5] Little, C. C., 1914. JOURNAL HEREDITY, 5:244-248.
[6] Barrows, W. M. and J. N. Phillips. *Loc. cit.*
[7] Galton, F., 1897. *Proc. Roy. Soc. Lond.*, 61.
[8] Castle, W. E., 1912. *Amer. Nat.*, 46:437-440.
[9] Hagedoorn, A., 1912. *Amer. Nat.*, 46:682.
[10] Ibsen, H. L., 1916. *Genetics*, 1:367-376.
[11] Barrows, W. E. and J. N. Phillips. *Loc. cit.*

in which white-bellied yellows differ from solid yellows. It should be added, however, that factors are known which produce effects as if of both class 1 and class 2, and the bicolor pattern of dogs may be one of these. Further data would be very welcome.

The relation of black-and-tan to black and to red is another question on which further data is necessary. There are three possibilities. The recessive factor by which the black-and-tan differs from black may be identical with factor e by which red differs from black. In this case, a subsidiary factor or factors must be supposed to modify a red into a black-and-tan. Second, the black-and-tan pattern may be due to an allelomorph of factors E and e, intermediate in effects. Third, it may be due to a factor independent of the extension series as supposed by Barrows and Phillips.[11] Ibsen quotes Barton to the effect that red by red may occasionally produce black-and-tan, and that black-and-tan by black-and-tan may occasionally produce red. Hagedoorn is also quoted, as stating that red may be dominant over black-and-tan. This evidence is easily harmonized with the first hypothesis above, but not so easily with the second and third. If the last proves correct, it must be supposed that reds are of two kinds, some dominant over black, some recessive.

LIVER COLOR IN DOGS

Perhaps the best established factor in dogs is one of class 2b. Lang[12] obtained indications, in a particular cross, that brown is recessive to black. Little[13] thoroughly confirmed this conclusion in Pointer dogs, and Barrows and Phillips[14] in Cocker Spaniels. This factor converts all black pigment in skin, fur and eyes to brown, thus changing solid black dogs to solid browns or "livers"; black-and-tans to liver-and-tans; and reds with black nose, ears and eyes to reds with brown nose, ears and eyes. Barrows and Phillips suggest further that red is reduced to lemon, but this seems inconsistent with their statement that both reds and lemons may have either black or brown points. Little speaks of yellows with brown points as somewhat duller than those with black points, but this may be due merely to reduction of a slight black sootiness in the fur to brown. On the whole there seems little reason for doubting that this factor may be compared with the chocolate-brown variations of rodents.

Longevity in Lily Pollen

During the season of 1916 I made a large number of crosses among my various lilies and wishing to use some of the earlier kinds with the later, I saved in small envelopes, the pollen of all the best early sorts to use later as later kinds bloomed. I found most of the pollen was good for two or three months saved in this way. Wishing to know if the pollen of some of the late ones might be kept over to use on the early ones in spring, I saved it from the *L. auratum*, wrapped in two or three sheets of paraffine paper and kept in a warm, dry place. Last spring I opened this and used it on a flower of *Lilium martagon*. The first application was a success and a good capsule of seed was obtained, but later this was tried on a lot of flowers of other lilies with no results. Only when the pollen was first exposed to the air was it potent. Care was taken to remove the anthers before the flower had opened and to cover well as soon as the old pollen had been applied. Had the pollen been divided and kept in separate envelopes so that it was used at once when first exposed to the air, I believe more capsules would have been fertilized.

F. H. HORSFORD,
Charlotte, Vt.

[12] Lang, A., 1910. *Zeit. Abst. Ver.*, 3:1-33.
[13] Little, C. C. *Loc. cit.*
[14] Barrows, W. M. and J. N. Phillips. *Loc. cit.*

MEANINGS OF GENETIC TERMS

Every New Science Coins New Words or Gives New Meanings to Others—Genetics Not an Exception to Rule—Scientific Workers Forced to Use Modern Terms—Explanation of Terms Should Help to Avoid Confusion[1]

ACQUIRED CHARACTER, a modification of a germinal trait. It is difficult to draw a line between characters that are acquired and those that are inborn. The idea involved is as follows: in a standard environment, a given factor in the germplasm will develop into a trait which varies not very widely about a certain mean. The mean of this trait is taken as representing the germinal trait in its typical condition. But if the environment be not standard, if it be considerably changed, the trait will develop a variation far from the mean of that trait in the species. Thus an American, whose skin in the standard environment of the United States would be blonde, may under the environment of Cuba develop into a brunet. Such a wide variation from the mean is called an acquired character; it is usually impressed on the organism after the germinal trait has reached a full, typical development.

Allelomorph, one of a pair of factors which are alternative to each other in Mendelian inheritance. Instead of a single pair, there may be a group of "multiple allelomorphs," each member being alternative to every other member of the group.

Allelomorphism, a relation between two or more factors, such that two which are present in one zygote do not both enter into the same gamete, but are separated into sister gametes.

Biometry, the study of biology by statistical methods.

Brachydactyly (short-fingeredness), a condition in which the bones, particularly of the fingers and toes, fail to grow to their normal length. In well-marked cases one phalanx or joint is wholly lacking.

Character (a contraction of "characteristic), a term which is used, often rather vaguely, to designate any function, feature, or organ of the body or mind.

Chromosome (so called from its affinity for certain stains), a body of peculiar protoplasm, generally cylindrical in the nucleus of the cell. Each species has its own characteristic number, the cells of the human body contain 24 chromosomes each.

Congenital, present at birth. The term fails to distinguish between traits which are actually inherited, and modifications acquired during prenatal life. In the interest of clear thinking its use should be avoided so far as possible.

Correlation, a relation between two variables in a certain population, such as that for every variation of one, there is a corresponding variation of the other. Mathematically, two correlated variables are thus mutually dependent. But a correlation is merely a statistical description of a particular case, and in some other population the same two variables might be correlated in a different way, other influences being at work on them.

Cytology, the study of the cell, the constituent unit of organisms.

Determiner, an element or condition in a germ-cell, supposed to be essential to the development of a particular quality, feature or manner of reaction of the organisms, which arises from the

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[1] Although material for this glossary has been borrowed liberally from many sources, it is not to be supposed that the definitions will meet with universal acceptance. It is believed, however, that they will at least help those who are not familiar with the vocabulary of genetics to understand what is meant when a certain word is used.—THE EDITOR.

germ-cell. The word is gradually falling into disuse, and "factor" taking its place.

Dominance, in Mendelian hybrids the capacity of a character, which is derived from only one of the two generating gametes, to develop to an extent nearly or quite equal to that exhibited by an individual which has derived the same character from both of the generating gametes. In the absence of dominance, the given character of the hybrid usually presents a "blend" or intermediate condition between the two parents.

Dysgenic, tending to impair the racial qualities of future generations; the opposite of eugenic.

Endogamy, a custom of primitive peoples, in compliance with which a man must choose his wife from his own group (tribe, clan, etc.).

Eugenic, tending to improve the racial qualities of future generations, either physical or mental.

Euthenic, tending to produce better cohditions for people to live in (but nor tending to produce people who can hand on improvement by heredity).

Evolution (organic), the progressive change of living forms, usually associated with the development of complex from simple forms.

Exogamy, a custom of primitive peoples which requires a man to choose a wife from some other group (tribe, clan, etc.) than his own.

Factor, a name given to the hypothetical *something*, the independently inheritable element in the germ-cell, whose presence is necessary to the development of a certain inherited character or characters, or contributes with other factors to the development of a character. "Gene" and "determiner" are sometimes used as synonyms of factor.

Feeblemindness, a condition in which mental development is retarded or incomplete. It is a relative term, since an individual who would be feebleminded in one society might be normal or even bright in another. The customary criterion is the inability of the individual, because of mental defect existing from an early age, to compete on equal terms with his normal fellows, or to manage himself or his affairs with ordinary prudence. American students usually distinguish three grades of mental defect: Idiots are those who are unable to take care of themselves, even to the extent of guarding against common physical danger or satisying physical needs. Their mentality does not progress beyond that of a normal two-year-old child. Imbeciles can care for themselves after a fashion, but are unable to earn their living. Their mental ages range from three to seven years inclusive. Morons, who correspond to the common acceptation of the term feebleminded, "can under proper direction become more or less self-supporting but they are as a rule incapable of undertaking affairs which demand judgment or involve unrestricted competition with normal individuals. Their intelligence ranges with that of normal children from seven to twelve years of age." There is necessarily a considerable border-line, but any adult whose intelligence is beyond that of the normal twelve-year-old child is usually considered to be not feebleminded.

Gamete, a mature germ-cell, in animals an ovum or spermatozoön.

Genetics for a long time meant the study of evolution by experimental breeding and was often synonymous with Mendelism. It is gradually returning to its broader, original meaning of the study of heredity. This broader meaning is preferable.

Germinal, due to something present in the germ-cell. A trait is germinal when its basis is inherited, as eye-color, and when it develops with nothing more than the standard environment; remaining relatively constant from one generation to another, except as influenced by reproduction.

Germ-plasm, mature germ-cells and the living material from which they are produced.

Haemophilia, an inability of the blood to clot. It thus becomes impossible to stop the flow of blood from a clot, and one who has inherited haemophilia usually dies sooner or later from hemorrhage.

Heredity is usually considered from the outside, when it may properly be

defined as organic resemblance based on descent, or the correlation between relatives. But a better definition, based on the results of genetics, looks at it as a mechanism, not as an external appearance. From this point of view, heredity may be said to be "the persistence of certain cell-constituents (in the germ-cells) through an unending number of cell-divisions."

Heterozygote, a zygotic individual which contains both members of an allelomorphic pair.

Homozygote, an individual which contains only one member of an allelomorphic pair, but contains that in duplicate, having received it from both parents. A homozygous individual, having been formed by the union of like gametes, in turn regularly produces gametes of only one kind with respect to any given factor, thus giving rise to offspring which are, in this regard, like the parents; in other words, homozygotes regularly "breed true." An individual may be a homozygote with respect to one factor and a heterozygote with respect to another.

Hormones, the secretions of various internal glands, which are carried in the blood and have an important specific influence on the growth and functioning of various parts of the body. Their exact nature is not yet understood.

Inborn usually means germinal, as applied to a trait. Strictly speaking, however, any trait which appears in a child at birth might be called inborn, and some writers, particularly medical men, thus refer to traits acquired in prenatal life. Because of this ambiguity, the word should be carefully defined when used, or avoided.

Inherent, synonymous with germinal.

Induction, a change brought about in the germ-plasm with the effect of temporarily modifying the characters of an individual produced from that germ-plasm; but not of changing in a definite and permanent way any such germ-plasm and therefore any individual inherited traits.

Innate, synonymous with inborn or germinal.

Latent, a term applied to traits or characters whose factors exist in the germ-plasm of an individual, but which are not visible in his body.

Law, in natural science means a concise and comprehensive description of an observed uniform sequence of events. It is thus quite different from the law of jurists, who mean a rule laid down for the guidance of an intelligent being, by an intelligent being having power over him.

Mendelism, a collection of laws of heredity, so called after the discoverer of the first of them to become known; also the analytical study of heredity with a view to learning the constitution of the germ-cells of animals and plants.

Mendelize, to follow Mendel's laws of inheritance.

Mores, the customs or unwritten laws of a people; the conventions of society: popular usage or folk-ways.

Mutation has now two accepted meanings: (1) a profound change in the germ-plasm of an organism such as will produce numerous changes in its progeny; and (2) a discontinuous heritable change in a Mendelian factor. It is used in the first sense by De Vries and other "mutationists" and in the second sense by Morgan and other Mendelists; confusion has arisen from failure to note the difference in usage.

Normal Curve, a curve of distribution of variations which are due to a multiplicity of independent causes acting equally in both directions.

Nucleus, a central, highly organized part of every living cell, which seems to play a directive rôle in cell-development and contains, among other things, the chromosomes.

Patent, a term applied to traits which are represented in the body as well as the germ-plasm of an individual. The converse of "latent."

Probability Curve, the same as normal curve. Also called a Gaussian curve.

Protoplasm, "the physical basis of life"; a chemical compound or probably an emulsion of numerous compounds. It contains proteins which differ slightly in each species of organism. It contains carbon, hydrogen, oxygen, nitrogen, sulphur and various salts, but is so complex as to defy exhaustive analysis.

Psychiatry, the study of diseases of the mind.

Recessive, the converse of dominant; applied to one of a pair of contrasted Mendelian characters which cannot appear in the presence of the other.

Regression, the average variation of one variable for a unit variation of a correlated variable.

Segregation, (1) as used in eugenics means the policy of isolating feebleminded and other anti-social individuals from the normal population into institutions, colonies, etc. Within these the two sexes are usually (and should always be) segregated from each other (2) The term is also used technically in genetics, rather vaguely and with various meanings, but primarily to refer to the separation of Mendelian factors through the independent distribution of such factors before or at the time of formation of the gametes.

Selection, the choice (for perpetuation by reproduction) from a mixed population of the individuals possessing in common a certain character or a certain degree of some character. Two kinds of selection may be distinguished: (1) natural selection, in which choice is made automatically by the failure to reproduce (through death or some other cause) of the individuals who are not "fit" to pass the tests of the environment (vitality, disease resistance, speed, success in mating or what not); and (2) artificial selection, in which the choice is made consciously by man, as a livestock breeder.

Sex-limited, a term applied to traits which differ in the two sexes, because influenced by the hormones of the reproductive glands. Baldness is possibly an example in man.

Sex-linked, a term applied to traits which are connected with sex *accidentally* and not physiologically in development. The current explanation is that such traits happen to be in the same chromosome as the determiner of maleness or femaleness, as the case may be. Color-blindness is the classical example in man.

Sexual selection, the conscious or unconscious preference by individuals of one sex, or by that sex as a whole, for individuals of the other sex who possess some particular attribute or attributes in a degree above or below the average of their sex. If the deviation of the chosen character is in the same direction (plus or minus) as in the chooser, the mating is called assortative; if in one direction independent of the characteristics of the chooser, it is called preferential.

Soma, the body as distinguished from the germ-plasm. From this point of view every individual consists of only two parts—germ-plasm and soma or somatoplasm.

Trait, a term used by geneticists as a synonym of "character."

Unit-character, in Mendelian heredity a character or alternative difference of any kind, which is apparently not capable of subdivision in heredity, but is inherited as a whole, and which is capable of becoming associated in new combinations with other characters. The term is now going out of use, as it makes for clearer thinking about heredity to fix the attention on the factors of the germ-cells instead of on the characters of the adult.

Variation, a deviation in the size, shape, or other feature of a character or trait, from the mean or average of that character in the species.

Vestigial, a term applied to a character which at some time in the evolutionary history of the species possessed importance, or functioned fully, but which has now lost its importance or its original use, so that it remains a mere souvenir of the past, in a degenerated or rudimentary condition. Example, the muscles which move a man's ears.

Zygote, the fertilized egg-cell, the united cell formed by the union of the ovum and spermatozoön after fertilization.

Zymotic, caused by a microörganism. A term applied to diseases. Example, tuberculosis.

SELECTION OF PLANT-BREEDING

JOHN BELLING, *Washington, D. C.*

FINAL selection of improved races by mere inspection has become, in most cases, more or less discredited among plant-breeders. The progeny test is now the main reliance of the breeder, and actual measurements are found to be usually more trustworthy than ocular estimates. Hence *selection* often includes some kind of testing before the act of choice. Without trial of some kind, selection consists in picking out the best looking individuals, in breeding for "fine feathers" and not for performance. This leads to pretty exhibits at the agricultural shows and county fairs, but does not cheapen the production of food. It is usually simple enough to pick out individuals which "*look*" better than the bulk of the crop, but to prove whether they *are* or *are not* better is often a longer process. In some cases the results of the progeny tests mechanically determine the best lines, with little or no personal selection on the part of the operator. Thus in improving Swedish wheat, Nilsson-Ehle takes at random plants of the old native wheat (which had already been shown to be a mixture of lines) and tests their progenies alongside for maximum crop, etc. Even in the progeny of crosses (*e. g.*, potato) where the plants are multiplied as clons (by scions, cuttings, tubers, etc.), the testing of the likeliest looking plants is often the hardest part of the work. Selection of seed-plants is carried on in two directions: (1) to obtain superior lines and (2) to breed them to constancy. The more genetic variation we have, the more material there is for selection. Bud selection, so far, has only scored notable successes in a very few cases. Even in potatoes most, if not all, of the recognized market varieties originated in crosses or seedlings. Crossing is the recognized means of gaining material for selection. It seems probable, for example, that most, or all, of the many strains of the common bean (Phaseolus) and of the cowpea were selected from natural or artificial crosses. The nurseryman's class of "sports" usually includes the products of natural crossing by insects. In plants which are naturally much crossed, as maize, a modified mass selection must be practiced, because of the loss in productivity which usually follows self-pollination or inbreeding. But in predominantly selfed crops, as beans and wheat, mass selection is no longer used, but strict individual pedigrees are kept. In such cases, progress depends on never mixing the seeds of two or more plants until relative constancy is obtained.

In all cases characters are selected directly and plants indirectly, and all knowledge gained in the progress of the work, or previously, as to the mode of inheritance of these characters, shortens and cheapens the process. Thus, with the increase of our knowledge which is in large part due to American workers, plant-breeding will be a more certain and a less costly operation than in the past. Even in the present, probably many plant-breeders who have created assured values for the community, have lost money in the work. This has been stated to be the case even with Luther Burbank, whose work is primarily commercial, and not research.

Rise in New Zealand Lambing Percentage

Authenic reports from New Zealand, states *Commerce Reports*, place the estimated percentage of lambing for 1917 at 88 per cent, as compared with 86 per cent for 1916. This means a gain, since there is an increase of between 200,000 and 300,000 ewes for the year. The entire outlook for the sheep industry in New Zealand seems promising.

POLYDACTYLISM AND TOOTH COLOR

S. Sinha
Professor of Botany, Berhampur College, Berhampur, Bengal

A STRIKING operation of heredity has been found in our thumb. My uncle has one extra family. He married a normal woman and had eleven daughters and two sons. Only one of the daughters, named Ujyala, has one extra thumb. The polydactyly was thus transmitted in the second generation. Ujyala was mated with a normal man and had one son and one daughter with normal fingers. Her husband is now dead. My uncle's fourth daughter, named Monda, has normal fingers; she was mated with a normal man of a family where did not exist any polydactyl man or woman in any generation. Monda has given birth to three sons and five daughters, only her second daughter has been born with an extra thumb. This shows that the polydactyl character was transmitted even in the third generation despite mating with a member of an untainted family. This polydactyl character remaining latent in Monda appeared in her daughter.

Davenport writes, as quoted in the Journal of Heredity, July, 1916, p. 324, "Polydactyl persons will have at least one-half of their children polydactyl. Those quite free from the trait, though of the polydactyl straits, will probably have only normal children." His statement of the mode of heredity was not found true in the records of our family. Out of thirteen children, my uncle has only one daughter with an extra thumb. His normal daughter, Monda, though mated with a normal man, did not have all normal children, as I have already told my readers.

COLOR OF TEETH

Another inheritance of character, not so striking as the previous one, has been observed in a Hindoo family of Bengal. "*A*'s" teeth were brown, *i. e.*, not exactly white. He was mated with a normal female; the mating resulted in the production of three sons and four daughters. The first and second sons, the first, second and fourth daughters of the family have brown teeth. *A*'s first son married a normal woman and had one son and one daughter. The daughter has brown teeth. *A*'s first daughter was mated with a normal man, which produced three sons and three daughters; only one of the sons got brown teeth. Thus the color character of teeth was transmitted even in third generation both by son and daughter of *A*.

Horse Breeding in Brazil

Since Brazil has come to realize its possibilities in ranching and similar operations, any measure which tends toward the betterment of animal breeding is sure to attract attention there. Data collected at a recent live stock census show that there are now six million horses and three million mules in the country. The Brazilian Congress is now discussing measures for the protection of the horse breeding industry, and has proposed a national equine stud to fix a type of Brazilian cavalry horse. There is at present no national type of horse, although excellent specimens abound, but by cross breeding it is hoped that a superior type may be fixed. Fifteen stations will be established if the bill is passed, managed by competent local authorities, while technical aid would also be secured from abroad. Money prizes would be offered, and interest stimulated in breeding, not only from superior stallions, but also from superior mares. The bill is being pushed vigorously by horse lovers and, if passed, would certainly assist greatly in maintaining breeding standards of the country along lines of true genetic worth.

The American Genetic Association

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MARCH, 1918

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WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, coöperative in nature. It is devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

It owns the JOURNAL OF HEREDITY, which is published monthly and sent free to each member.

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Membership is composed of men of science, teachers, publicists, physicians, clergymen, parents, students, horticulturists and breeders of live stock, etc., throughout the world.

Subject to the approval of the council, any person interested in the improvement of the human race or the creation of better varieties of plants and animals, is eligible for membership.

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THE AMERICAN GENETIC ASSOCIATION

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The

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(Formerly the American Breeders' Magazine)

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A SQUARE MEAL—TORTILLAS AND AVOCADO

Tortillas are made from maize or Indian corn which has been treated with lye and ground coarsely upon a stone. Four or five of them and a good sized avocado are looked upon by the average Guatemalan Indian as a good meal. The avocado is eaten without the addition of anything more than a little salt, and a bit of tortilla serves as a spoon. (Frontispiece.)

AVOCADOS AS FOOD IN GUATEMALA

A Fruit of Particular Interest at this Time When Products of Great Food Value Are Receiving Much Attention—Its Importance Among the Guatemalan Indians—Analyses Show High Oil Content

WILSON POPENOE

Agricultural Explorer, Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry.

NORTH Americans, particularly those who have been watching the development of the avocado industry in California and Florida, are familiar with the statement that the avocado is a fruit of "unusual food value." There is no occasion for disputing such a statement, yet it does, perhaps, need to be interpreted. We recognize the olive as a fruit of "unusual food value," likewise the date. Will the avocado, then, take a place in our national economy comparable to that held at present by either the olive or the date?

While no one can foresee the extent to which the avocado will eventually be used in this country, it is suggestive to examine its status in other countries and its claims upon our favor. The increasing popularity of the avocado in the United States is doubly encouraging when we remember that it has developed upon the use of this fruit as a salad, almost as a luxury. If it is so acceptable to the American palate that it will be purchased at high prices and consumed solely for the gustatory pleasure which it produces, what rôle will it play when it can be obtained so cheaply that it will compare favorably, pound for pound, with other foods as a source of bodily energy and repair?

The American palate is eccentric. It may truthfully be said that it is too eccentric. At the present time we are making the greatest effort in our history to control our eccentricity and eat things for which we have never possessed a predilection or even have enjoyed, because we know them to be good foods and because certain other foods, of which we are more fond, are needed by our armies and by our allies. It has always been difficult to place a new food upon American tables. The mere fact of its being unusual—something to which we have been unaccustomed—is sufficient to make us turn it down, in nine cases out of ten, without even giving it a fair trial. Strange, is it not, how obstinate we are in matters of this sort? We are willing to wear new kinds of clothing—in fact we delight to do it—but many of us will not try new foods.

Yet in spite of this prejudice against foods which we are not used to eating, the avocado has made rapid strides toward popularity. One factor in its favor has been the high price demanded for the fruits. The psychological effect of this cannot be denied. It is difficult for anyone to pay 75 cents for a small portion of avocado salad, and then refuse to eat it. And if he eats it, even though he convinces himself, by an elaborate process of reasoning, that he does not like it, the worst of the battle is over. The avocado is a new taste. It is not a disagreeable taste, it is simply new. Once the palate is accustomed to it, a liking is soon developed, and I have yet to hear of a case where anyone sampled a *good* avocado three times and still maintained that he did not like it.

A DELICIOUS FRUIT

As far as can be judged from the experience of the past ten years, Americans in general are going to like the avocado immensely. Probably not one per cent have tasted it as yet, but among those who have been fortunate enough to do so there is no question regarding the popularity of this fruit. It must be

AN APPETIZING, CHEAP, AND WHOLESOME FOOD

In the small towns of the Guatemalan highlands good avocados are sold at half a cent each, or even less. In the capital itself, where they must be brought from distances of 10 to 50 miles, they are high when the price is more than one cent. At such prices it is doubtful if there is any other food which can compare with the avocado in value. And in addition to being cheap it is a tasty food, and so wholesome that it can be used regularly as one of the major articles of diet. (Fig. 1.)

admitted that the avocado is delicious. It is a taste which grows upon one. The delicately rich flavor of its soft creamy flesh is pleasant and satisfying to a degree rarely experienced. While it is most commonly eaten with the addition of nothing more than a little salt and a dash of vinegar or lemon juice, it blends admirably with certain other foods. In Guatemala, for example, it is the custom to add diced avocado to meat soups at the time of serving, while in Cuba a delicious omelet is made by adding finely diced avocado in the same manner as cheese is used in the North.

Granting that the avocado can be grown successfully in the United States, a statement no longer open to question, what may we expect of it in the future? It is not my purpose to offer prophecies, but to point out by a brief description of conditions in Central America, what the avocado *can* mean to a people who have an abundant supply of the fruit during a large part of the year.

The Maya race, which formerly inhabited the lowlands of southern Mexico, Guatemala, and northern Honduras, is broken up into various tribes now occupying the highlands of Guatemala, extending northward into the lowlands of Yucatan, Tabasco, and Chiapas. Like their ancestors, the Mayas are an agricultural people whose principal crop is maize or Indian corn. They supplement this staple article of diet with squashes, beans, avocados, meat and a few other products.

In certain portions of the Maya territory the avocado is eminently at home. It not only grows in almost every dooryard, but also in the edges of cultivated fields and along the roadsides, yielding generously of its handsome fruit, although it receives no care from man. This is particularly true in those sections of the Guatemalan highlands which are occupied by the Cakchikel, Kiché and Kekchi tribes. The long ripening season makes it possible to eat avocados during eight months of the year; their abundance results in their being so cheap that only the best varieties have any monetary value at all, inferior ones, such as small fruits with very large seeds, not bringing enough to pay for carrying them to market. The best fruits, when offered for sale in the little Indian villages tucked away in the Guatemalan mountains, may realize as much as two *reales* each—the equivalent of about half a cent. Ordinary fruits seldom bring more than a *real*.

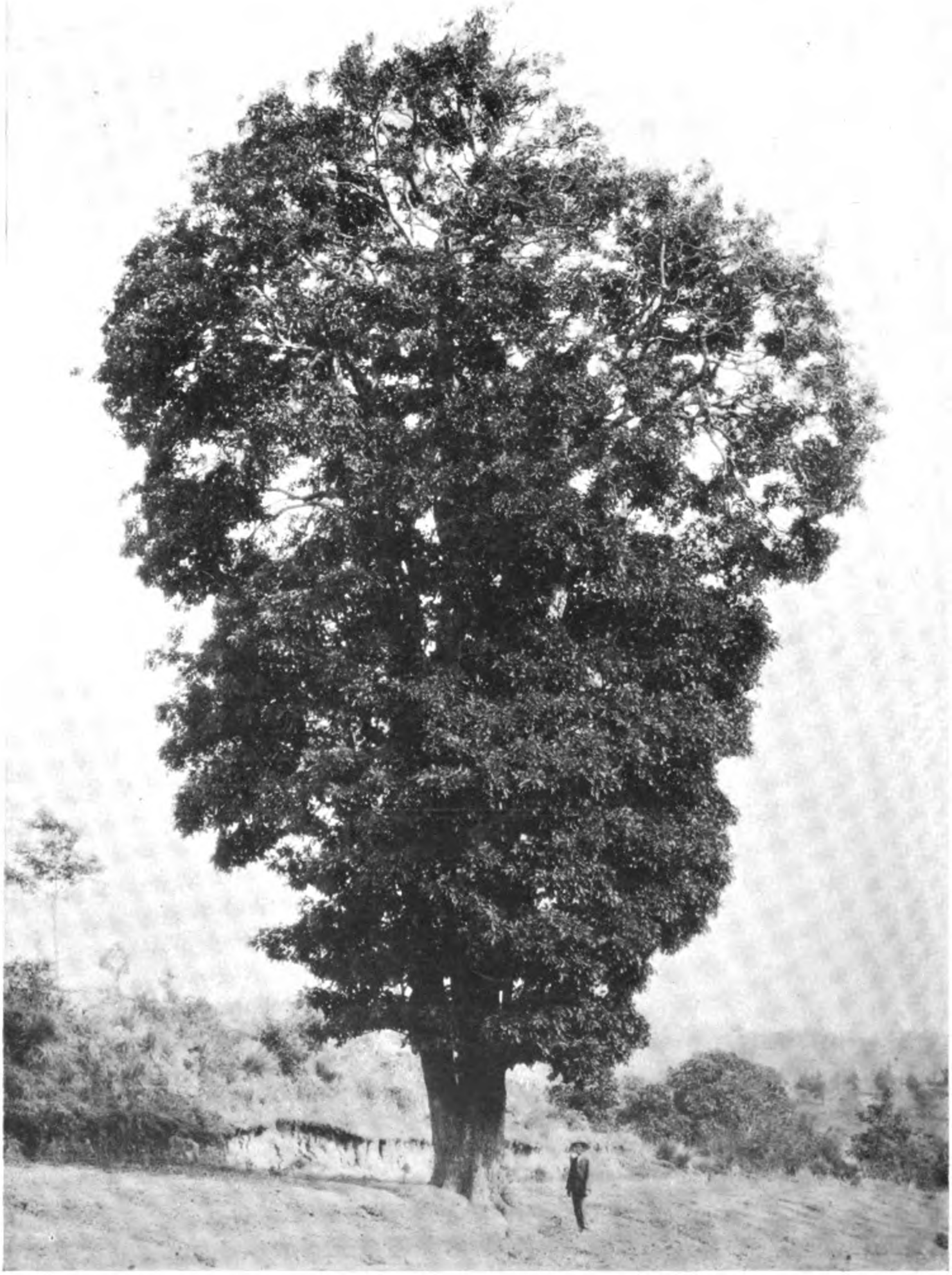
Here, then, is an interesting state of affairs: avocados in abundance, and at prices which place them within the reach of the poorest villager. If avocados are ever to assume an important place in the dietary of any people, we would say, they should certainly do so here.

PRACTICALLY REPLACES MEAT

It is difficult for one who has not actually visited these regions to appreciate the extent to which the avocado replaces meat in the dietary of these industrious folk. It must be understood that meat, in Guatemala, is a luxury to be indulged in mainly by the well-to-do, its use among the poorer classes being very limited.

Let me illustrate the Guatemalan's attitude toward the avocado by a few incidents which came under my observation. My assistant on numerous collecting trips among the Guatemalan mountains was a full-blooded Kekchi Indian, José Cabnal of Cobán. In telling me of the customs of his people he touched upon the question of food. "Four or five tortillas," said he, "a good sized avocado, and a cup of coffee—this we look upon as a good meal." The tortilla, as is well known to many Americans, is nothing more than a thin cake made from maize, which has been treated with lye and ground coarsely on a stone.

Later, while stopping one noon in the village of Panajachél, high up in the mountains on the border of Lake Atitlán, I chanced to step out into the central plaza or square, where there were a number of Indian *cargadores* en route from Sololá to Guatemala City with loads of pottery on their backs. They had stopped for their noonday meal, and as I approached them I saw that each one had half an avocado in one hand, which he ate with



MAXIMUM DEVELOPMENT OF THE AVOCADO TREE

Such trees as this, probably a century or more in age, are rare in Guatemala, but serve admirably to illustrate the habit as well as the maximum development of the avocado. Only on good heavy soils can such dimensions be attained. A mature tree will sometimes bear as many as two thousand medium sized fruits, or a thousand large ones. (Fig. 2.)

a bit of tortilla held in the other. Maize and avocados. Apparently this is a diet which the Indian finds sustaining under the most severe physical exertion, for there is no harder work than that of the cargador, who frequently carries a hundred and fifty pounds on his back, and thinks nothing of making a journey of a hundred miles in five or six days. And he likes this diet so well that he makes no effort to improve it, even by seasoning his avocados, although salt is sometimes used. When he has no tortilla to use as a spoon, he will scoop out the avocado pulp with his right index finger.

While staying in Guatemala City, I often found it necessary to purchase large quantities of avocados in order to obtain the seeds. These fruits we piled in a corner of the patio, covering them with straw to hasten ripening. Every few days it was necessary to go over the pile and pick out the ripe fruits. The seeds were then removed, and the halved fruits thrown to one side. Before we had progressed far with this work, José inquired what we were going to do with the pulp. I replied that he could dispose of it as he chose, whereupon he notified all the neighbors, and thenceforth there was a constant procession of natives coming in through our gate with baskets or boxes on their heads, and going out with loads of avocado pulp. This they took to their homes, and as long as it lasted they needed no other food except the ubiquitous tortilla.

It must be admitted that the tortilla is a highly sustaining article of diet, even though it may be, as Charles Macomb Flandrau happily puts it, a melancholy form of nourishment. But I do not recall having met a Guatemalan who would voluntarily choose to make a meal on tortillas alone, while I do recall having seen many who seemed quite content with tortillas and avocados.

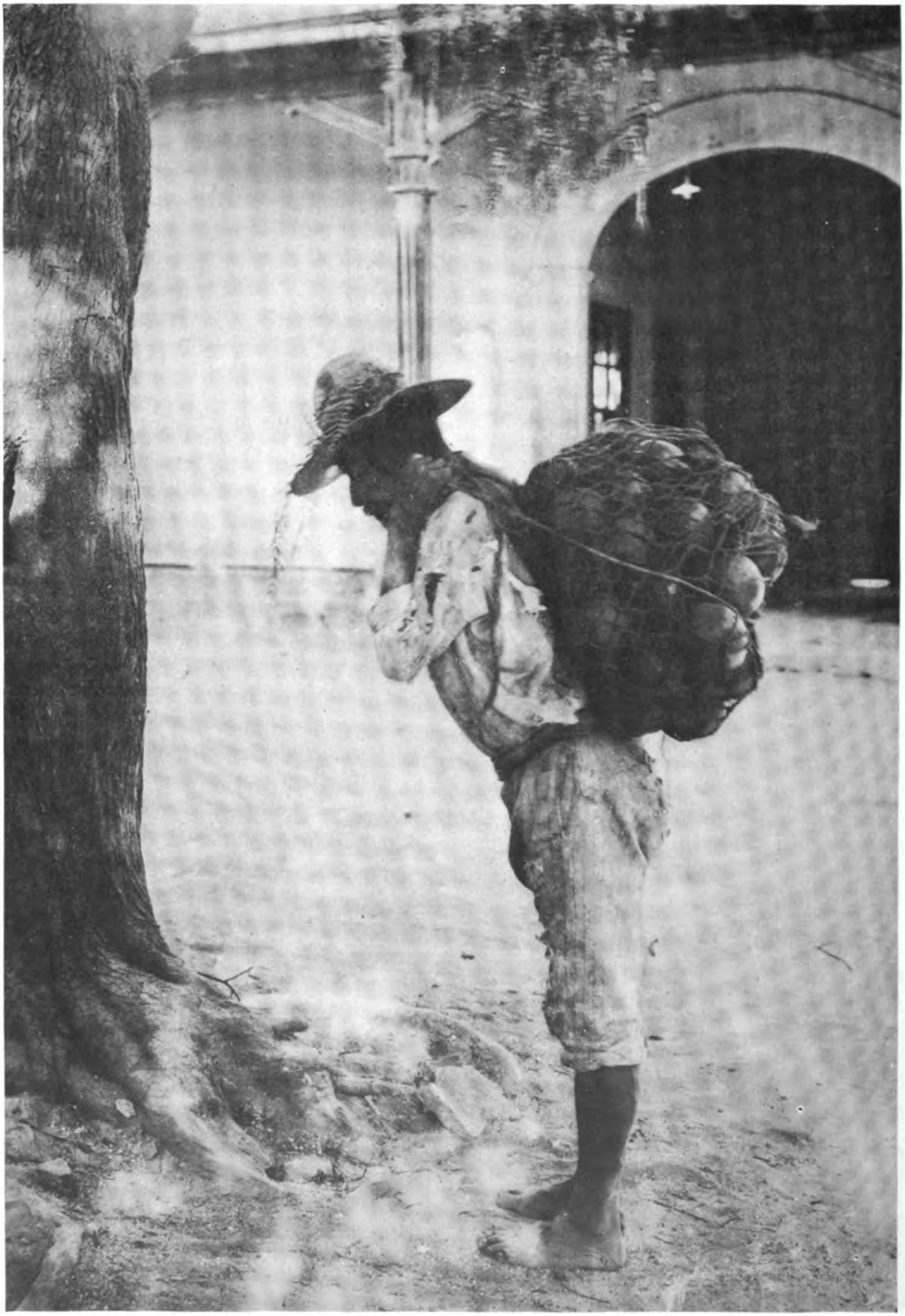
Walking through the streeets of Purulá, a village in northern Guatemala, I chanced to see a fine avocado tree standing behind the hut of an Indian family. I entered the yard to make inquiries, and was invited into the house to inspect some of the fruits. It was a typical Indian hut, mud floor, thatched roof, and sides made of poles lashed together with lianas. A smoke-covered pot of black beans was slowly bubbling over a fire burning in the middle of the floor, and the omnipresent *ká* or grinding stone, on which maize is prepared for tortillas, stood to one side. A few feet overhead, and directly above the fire, a basket of avocados was suspended from the rafters. Their presence over the fire may be explained by the statement that it is a common practice to put avocados in a warm place during the ripening process.

Maize, beans, and avocados. A glance around the room showed no other foodstuffs of any kind. Probably meat would be purchased occasionally, and a savory stew in which chile peppers, squashes, and tomatoes appeared, would be the result. But maize, beans and avocados were the principal staples in this household, just as they are in many other Guatemalan homes.

These incidents, typical of many experienced during a year's travel in Guatemala, indicate the Indian's attitude toward the avocado and the manner in which he uses it. It is not to be assumed, of course, that North Americans will consume their avocados in such a primitive manner as do the Guatemalan Indians. It is not necessary that they should do so. The fats and the proteins and the carbohydrates locked up in the fruit are just as available to those who eat a delicate avocado salad as they are to the aborigine who takes the unseasoned pulp with a scrap of tortilla.

CONSTITUENTS OF THE AVOCADO

Thanks to the investigations of such men as Professor Jaffa of the University of California, we are gradually acquiring knowledge regarding the various constituents of the avocado, and the proportions in which they occur. An interesting table published by Jaffa in Bulletin 254 of the Agricultural Experiment Station at Berkeley shows that, as a result of 28 analyses, including about 24 varieties, water was present in the pulp or edible portion of the fruit in



STARTING TO MARKET WITH A LOAD OF AVOCADOS

Throughout the Guatemalan highlands there is an avocado tree in nearly every dooryard. From some regions, such as Antigua, where the trees are particularly abundant, large quantities of the fruit are carried to the markets of Guatemala City, at least a day's journey across the mountains. Indians who are trained for this work can carry a hundred and fifty pounds without difficulty. (Fig. 3.)

percentages varying from approximately 60 to 80, with an average of 70. Protein was present in amounts varying from 1.30% to 3.70%, with an average of 2.08%. The percentage of fat varied from about 10 to 30, with an average of 20.1. Carbohydrates were present in varying quantities, the lowest analysis showing 3.69% and the highest 16.17%, while the average was 7.39%. Finally, the amount of ash varied from 0.60% to 1.93%, with an average of 1.26%.

As pointed out by Professor Jaffa in his explanation of these analyses, the total dry matter in the edible portion of the fruit is greater in the avocado than in any other fresh fruit, the nearest approach being in the case of the banana, which contains about 25%. The protein content is also high for a fresh fruit, approaching closely that of some of the dried fruits in common use. In Professor Jaffa's own words, "so far as protein and ash in fresh fruits are concerned, the avocado stands at the head of the list, and, with reference to carbohydrates, contains on an average fully 50% of that found in many other fresh fruits. These facts alone would warrant due consideration being given to the value of the avocado as a fresh fruit. The chief value of the avocado as food, however, is due to its high content of fat. This varies, as shown by the analyses, from a minimum of 9.8% to a maximum of 29.1%, with an average of 20.1%."

As to the caloric or energy-producing value of the avocado, one pound of the pulp represents about 1,000 calories, on an average, the maximum and minimum being 1,325 and 597 respectively. The maximum "corresponds to about 75% of the fuel value of the cereals and is not far from twice that noted for average lean meat."

Summing up his remarks to the meeting of the California Avocado Association in October, 1915, Professor Jaffa said: "It would appear that the avocado may be said to be, as far as fruits are concerned, in a class by itself, containing on the average a far higher caloric value than any other fresh fruit except the olive, and in view of the fact that it ranks higher in fat or oil than the average or commonly used olive, it outranks even this fruit with respect to its total food value."

It may be interesting, just at this point, to append a brief table comparing the caloric or fuel value of the avocado with that of a few other foods. For this purpose an average variety should be taken, *i. e.*, one in which there are approximately 1,000 calories to a pound of pulp. In considering the table it must be remembered, therefore, that the position of the avocado would be changed were a variety having a high caloric value chosen in place of an average one.[1]

	Calories
100 grams (about 3½ ounces) boiled rice	322
100 grams white bread	246
100 grams avocado	218
100 grams egg	166
100 grams lean beef	100

It must not be assumed from this table that the avocado has a total food value greater than that of lean beef. It is only the caloric values which are shown, and much of the value of meat as a food lies not in the energy which it produces, but in its ability to build up and repair the tissues of the body.

INTERESTING POSSIBILITIES IN OIL

The presence of such a large percentage of oil in the avocado has suggested that this fruit might yield a table or cooking oil which would be as valuable as olive oil, peanut oil, and other products of this nature. The lack of material in this country for experimental purposes has retarded investigation of the subject, but it has been found by the Bureau of Chemistry that a thick white fat can be extracted by hydogenation which strongly resembles some of the cooking fats now on the American market, and A. C. Hagemann, of New York, in experimenting with avocados of the Mexican race grown at Miami,

[1] The values given in this table, with the exception of that for the avocado, are adapted from Hutchison's *Food and Dietetics*, 4th ed., 1917, p. 426.

A CENTRAL AMERICAN CONTRIBUTION TO THE WORLD'S FOOD SUPPLY

The small tree, whose trunk is seen in the photograph, produced over a hundred 1-pound fruits in a single crop. When it is realized that each of these fruits contains as much nourishment as a small loaf of bread, the enormous value of the avocado as a source of human food is readily appreciated. (Fig. 4.)

Florida, was able to extract a green oil very much like olive oil in character. While of bland, pleasant flavor, it possessed a slightly bitter after-taste which was somewhat disagreeable. Further experimentation would probably lead to the discovery of a method of removing this quality.

It will doubtless be many years before there will be a large enough supply of avocados in the United States to permit of their use for the extraction of oil, yet the subject is one which must eventually receive much attention. It is possible that the large quantities of avocados annually produced in the American tropics might be utilized in the near future for this purpose.

A comparison of the possibilities of the avocado with the olive as an oil producer is suggestive and striking. According to Professor Bioletti of the University of California (writing in Bailey's Standard Cyclopedia of Horticulture), olives in California produce from one-half ton to over four tons of fruit per acre. In France, 2.7 tons is considered a maximum yield, and good orchards are not expected to yield more than 1.3 tons. One ton of olives is calculated to yield about 35 gallons of oil. The production of oil per acre, therefore, varies in California from a minimum of 18 gallons to a maximum of 140. The average is said to be about 50 gallons.

In Florida, an orchard of Trapp avocados at five years of age has produced an average of four crates of fruit per tree. Since there are 80 trees planted to the acre, this gives 320 crates of fruit per acre. Each crate contains an average of 40 avocados which weigh about 12 ounces each; in other words, a crate contains 30 pounds of fruit. One acre therefore produces 320 times 30 or 9,600 pounds of fruit.

In the analysis of the Trapp variety made by Professor Jaffa the edible portion or pulp was found to constitute 71.5% of the entire fruit. The 9,600 pounds of fruit obtained from an acre would therefore furnish 6,864 pounds of pulp. The same analysis shows the percentage of oil in the Trapp variety to be 9.80. The entire amount of oil in this 6,864 pounds of pulp is therefore 672 pounds. Calculating roughly that there would be 7 pounds of oil to the gallon, this would make 96 gallons of oil. We are assuming, however, that *all* of the oil is saved, whereas Bioletti states that only 50 to 65% of the oil contained in the olive is recovered by the process of extraction practiced in California at the present day. Naturally, since avocado oil has not been extracted commercially up to the present time, it is impossible to say what percentage will be lost. Hagemann, in his limited experiments, found that 18.5% of the entire weight of the pulp was extracted as oil. It is unlikely that the pulp originally contained more than 30% of oil, and it probably contained considerably less. But calculating that the maximum amount quoted for olives, 50%, will be lost in extraction, we still have 48 gallons of oil, which is practically the same as the average obtained from the olive in California today.

With every allowance for loss in extraction, then, an acre of Trapp avocados would yield as much oil as an average acre of olives in California. Recalling that the percentage of oil in the Trapp is not quite 10, while in some other varieties it is as high as 30, the possibility of getting more oil from the avocado than from the olive becomes apparent at once. The whole subject is new, of course, and the calculations just given, while based on actual figures obtained in Florida avocado groves and in laboratory analyses of the fruit, cannot be considered as anything more than suggestive of the possibilities of this interesting fruit along one very important line, the production of oil.

THE NASSAU SURVEY

Study of Mental Disorder and Social Maladjustment in a Typical Community—Small Part of the Population Makes Most of the Trouble—Institutional Care Would be an Economy.

IN EVERY community there are a certain number of people who do not fit into the social organization. They cannot earn a living, or they cannot keep the peace, or they cannot stay sober, or for some similar reason they earn the right to be labeled "cases of social maladjustment" by the man of science.

How many such cases are there in a typical American community, and to what extent is their maladjustment to be attributed to mental disorders?

Many communities have attempted to answer these questions, but no attempt has been more painstaking than that of the "Nassau Survey," which examined a representative county of Long Island last summer. The report of this survey was prepared by the director, Dr. Aaron J. Rosanoff, and is published by the National Committee for Mental Hygiene.[1]

The survey itself, as readers of the JOURNAL OF HEREDITY will recall, was the outgrowth of the work of the Nassau County Association, whose committee on Health and Eugenics undertook, as long ago as 1913, to ascertain what families in the community were supplying mental defectives to the population. In the final and ambitious project carried out last summer, many agencies coöperated: The National Committee for Mental Hygiene, the Rockefeller Foundation, the United States Public Health Service, the Eugenics Record Office, and various New York state organizations and institutions.

Nassau county was considered particularly worth while surveying because "it would be difficult to find anywhere another county which is not too large or too populous and which, at the same time, as fully represents the widely varied features of American life." "It has many families descended from Colonial and Revolutionary stock; it has an ample representation of newer immigrant stocks, especially Slavonic and Italian; and it has a considerable colored population."

INSTANCES OF MALADJUSTMENT SOUGHT

The question which the survey set out to answer was not, as it might have been a few years ago. "What is the percentage of 'insane' or 'feeble-minded' or 'mentally defective' persons in the community;" but rather 'What instances of social maladjustment, sufficiently marked to have become the concern of public authorities, are, upon investigation, to be attributed mainly or in large measure to mental disorders?" Some abnormal cases without social maladjustment were naturally brought to light as a by-product of the work. Says Dr. Rosanoff:

"Wherever the abnormality could be established beyond question by medical diagnosis, in spite of the absence of social maladjustment, the case was included in the enumeration. It is significant that over 10% of the abnormal cases found by us showed no social maladjustment; and even more significant is the consideration that had it been our deliberate purpose to bring such cases to light, the percentage would undoubtedly have been much higher."

From the eugenic point of view, however, such a consideration does not seem to the reviewer to be beyond

[1] Survey of Mental Disorders in Nassau County, New York, July-October, 1916. Report prepared by Dr. Aaron J. Rosanoff (director of the Survey). Pp. 125, price 25 cents. The National Committee for Mental Hygiene, Inc., publication No. 9; 50 Union Square, New York, 1917.

criticism. It may be easy to find a feeble-minded man, for instance, who has never given any trouble to the police or county authorities; but what will his children be? To take the behavior of an individual as the most important criterion of his social worth may frequently lead to dangerous results.

In a brief review it is not possible to do justice to the abundant data contained in the 125 pages of Dr. Rosanoff's report. Only the more salient conclusions can be suggested.

In the course of the survey 1,592 mentally abnormal cases were brought to light—a percentage of 1.72 for the county. This is recognized as being below the true figures. There was an excess of Negroes among these; but apart from them the native-born whites contributed relatively more defectives than the foreign-born.

"It is probable," Dr. Rosanoff explains, "that wherever in this country old settled communities live in a rural or semi-rural environment, as in Nassau county, conditions prevail which tend to result in the segregation of certain contrasted mental traits in branches in each family; many of the more able and enterprising members of families are attracted to the cultural and industrial centers, failing to find full scope of opportunity in local affairs; those who remain behind thus include a larger proportion of the mentally inferior than is characteristic of the family as a whole; in the course of generations the contrast is further accentuated by the intermarriage of more or less inferior members of different branches of the same family, or by the union of members of equally inferior branches of unrelated families, on the general principle of like mating with like. Thus there are probably many American families consisting, like the now famous 'Kallikak' family, of 'good' and 'bad' branches; and among the most defective old native families discovered in the course of the survey are some bearing names which are also borne by others noted for culture and achievement."

An important finding is that the abnormal part of the population shows a greater tendency to remain single or to divorce and separate. It appears to Dr. Rosanoff that there is no ground for apprehension of any increase of mental disorders, so far as the birth rate is concerned. But there are abundant figures which point in the opposite direction, and few eugenists will venture to give Dr. Rosanoff's finding in this respect a widespread application at present.

To study the influence of heredity was not a primary part of the plan; yet the material furnishes, in Dr. Rosanoff's opinion, "an addition to the already ample evidence showing that in the causation of mental disorders heredity appears as a highly important factor."

Of the 1,592 abnormal cases found, 41.6% are or have been in institutions. It is judged that 59.4% require temporary or permanent institutional treatment; 29.5% require other treatment (private custody, medical care, etc.); and 12.1% require no treatment. Many of the persons in custody are in institutions wholly unsuited to their needs.

It would seem conservative on the part of the state in Dr. Rosanoff's opinion to double its institutional provisions on the strength of this finding without the slightest danger of such increased provision ever proving to be in excess of the needs.

"The types of institution for which there is particularly urgent need are: (1) schools and colonies for the feebleminded; (2) separate institutions for defective delinquents with provision for classification by sex, age, and perhaps susceptibility to reform; (3) industrial colonies for inebriates, vagrants, etc.; either separate institutions for epileptics or special wards for them in state hospitals or in schools or colonies for the feebleminded."

The inadequate attention paid to mental differences in children as well as adults is commented upon; more special classes are said to be required.

PROPOSED REGISTRATION EXPLAINED

"The registration of mental disorders has been many times proposed, but no effective and practical method of pro-

cedure has been offered. Our experience has led us to feel that, for guidance in this enterprise of registration, the best case is to be made out for the sociological principle. The mind is nothing but an instrument of adjustment of the organism to its environment; and for practical purposes it would seem necessary but to take cognizance of instances of mal-adjustment sufficiently marked to come to the notice of public officials, charitable organizations, and physicians.

"More specifically, the register in each state may include:

"1. Cases admitted to hospitals for the insane, public or private.

"2. Cases admitted to institutions for inebriates, epileptics and the feeble-minded.

"3. Cases convicted of any crime, exclusive of violations of local laws and ordinances.

"4. Cases coming to light in suits for separation or divorce.

"5. Cases admitted to almshouses.

"6. Cases applying for outdoor relief to overseers of the poor or private charitable organizations.

"7. Some provision for the registration of data pointing to possible abnormality in children in public elementary schools, orphanages, etc.

"8. Mental cases coming to the notice of physicians in private practice.

"Each individual thus registered should receive an identification number; and future instances of mal-adjustment reported in his case should be added to his record and not registered as new cases.

"The first registration, it need hardly be said, would by no means imply in all cases a judgment of mental abnormality. It is obvious, on the contrary, that a register containing all such cases will include many quite normal individuals. The object of compiling a register in the manner here proposed would be to make sure of including all cases of marked mal-adjustment and yet avoid a premature judgment as between normality and abnormality.

"Judging from the results of this survey, it may be anticipated that after several years development such a register will show that the bulk of all crime, vice, dependency and other maladjustments in a given commonwealth is attributable to a comparatively small fraction of the population. Naturally, problems presented by such evils could be attacked more successfully with the aid of material that would be available in such a register than without it.

"The relationship between mental disorders and dependency deserves special consideration owing to its bearing on the question of state provision such as is here advocated. It was shown that of 1,592 mentally abnormal cases 473 were characterized by dependency either as a primary or secondary manifestation; but this number does not include cases found in state hospitals, correctional, penal and other institutions. It is safe to say that at least two-thirds of all the abnormal cases are partly or completely dependent.

GREATER APPROPRIATIONS NECESSARY

"Legislatures throughout the country seem to be loth to make appropriations for the construction of more housing facilities, being disinclined to assume for the state the burden of caring for such large numbers of mental defectives. We have shown, however, that mental defectives are, for the most part, already dependent; in other words, they neither starve nor go without raiment or shelter, but are maintained at the expense of others, receiving support from overseers of the poor, charitable organizations, neighbors, friends, relatives, or from strangers by begging.

"The cost of maintenance of such cases in public institutions is annually between $150 and $200 per capita. This is accomplished through economies rendered possible only by an institutional organization. It is not possible for dependents living at large to be maintained, by whatever means may be available, at such low cost. What their maintenance actually costs under such conditions no one knows; but whatever it is, it is usually not taken into consideration because it does not appear in legislative budgets in large lump sums. Yet the fact is that institutional provision for such cases is not an added expense to

commonwealths, but is a better organized, more economical way of bearing an already existing financial burden, and a more equitable distribution of it.

"The losses that result from spreading venereal infection, from theft, from incendiarism and other anti-social tendencies of mental defectives should also be included in the reckoning; and, from the standpoint of future generations, their unrestrained propagation, when at large, both in and out of wedlock."

Infant Welfare Work in War Time

Now that the United States has entered the war, it is evident that difficulties will be encountered in this country similar to those which have been met in the nations already at war. Although conditions in other countries are different in many respects from those in this country, a study of foreign material will discover many general tendencies for good which can be imitated and other tendencies which should be avoided. Most noticeable in every warring country has been the fact that protection of infancy and maternity has greatly increased in every instance, and the preventive rather than the palliative side has been followed in almost every case by the governments in establishing infant welfare stations, maternity clinics and similar institutions, says Grace L. Meigs in *American Journal of Diseases of Children*, August, 1917.

The work done in England is especially interesting. The same urgency has not been felt there as in France because of a higher natural birth rate. Just before the war Parliament was considering making a grant to aid sanitary authorities and the war has had the effect of directing greatly increased attention. The employment of pregnant women and nursing mothers is one of the most vital problems and undoubtedly has a great influence on the infant mortality rate. In Scotland about the same measures have been carried out as in England.

In Germany, our knowledge of conditions is far less complete, but the same lines seem to be followed out as have been found necessary and advantageous in other nations. France has decided upon four measures. These are:

1. The military allowance given to the mother of the children of soldiers whether legitimate or illegitimate.
2. The government maternity grant, which was established by the act of June 13, 1913.
3. The grant given by the government to large families.
4. The help distributed by the *Assistance publique* and by the maternity hospitals, whose object is to enable the mother to care for her baby herself.

The importance of protecting pregnant women and nursing mothers in factories is also recognized, but it is thought that not more than 4% of women so employed belong in these two classes.

Belgium seems to have been able to decrease the infant mortality rate except in Mons. The work in Italy and Russia is not well enough known to permit definite statements regarding conditions there. In New Zealand and Canada, there is not much evidence that much effort has been made along preventive lines, but there is evidence that the work has suffered from the loss of physicians and nurses called to service. The situation there is somewhat analagous to that in the United States, since both are far removed from the scene of conflict.

To sum up the matter it seems that no hasty conclusions should be drawn as to what is immediately necessary in this country; that the chief preventive measure for protecting babies is to insure their care and nursing by healthy mothers in their own homes; and that preventive work should be made the central effort.

GARDENS FOR PLANT BREEDERS

Requirements Necessary for Encouragement of Plant Breeding Heretofore Misunderstood—Environment Usually Not Suitable for Really Constructive Work—Breeder Should be in Close Touch with His Plants

David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

WHY cannot we realize the conditions necessary for the encouragement of plant breeding and go ahead and create them? Seen from a perspective which reaches back to the establishment of the experiment stations in this country, it appears to me that we have misunderstood these requirements. The environment of the State Experiment Station is as far as possible from what could be considered ideal for the plant breeder, and I am confident that one reason why, today, with all that has been published about plant breeding, we have so amazingly few practical breeders is because we have misunderstood the requirements of a plant breeder.

The laboratory in a big station building which may have the name "Plant Breeding" on the door is not a place where plant breeding is done. It is a place where the subject is discussed and the laws of heredity are disputed and new principles are worked out, but it is not the place of origin of new varieties of practical importance to the human race. Why should we not recognize in the equipment of the plant breeding laboratory that plant breeding is an early morning occupation, and that the materials with which the breeder deals are of the most fleeting nature—that, like the appearance and disappearance of a comet in the sky, the simultaneous flowering side by side of two plant species is often the event of a plant breeder's life time, and that, unless he is on hand and fully prepared to make immediately a host of crosses, only one of which perhaps succeeds, he never gets another chance at it, and years pass, in all likelihood, before another breeder succeeds in getting the plants in bloom together. In the hybridizing of trees and shrubs, this is peculiarly true. The making of crosses is a very different kind of work from that of the investigator of alcoholic specimens or the microscopic studies of lower plant life.

FORCED FROM PRACTICAL FIELD

As I look over the field, it would seem as though the plant breeders who, under the right environment, would have produced new plants of the greatest value, have been forced by the difficulties which surrounded them, to enter those statistical and microscopic phases of plant breeding which can be done in the indoor laboratories, equipped with microscopes and slide rules. I am not in the least discounting the value of this work, but it does seem as though, by the expenditure of a small amount of money, we might make what would appear to be the most attractive places imaginable for men with a real fondness for plants—places from which would be coming year after year new hybrids and selections of the greatest value to the horticulture and agriculture of the world.

It has been my good fortune to be associated in a helpful capacity with several plant breeders in this country, and, as I look over their surroundings, it seems to me that they have one thing in common. They live among their plants —not a mile or two away from them.

I remember the remarkable place of C. P. Gillett, which he called the Barren Hill Nursery, and which he had transformed into a little paradise of fascinating plants at Nevada City, Cal. I

HYBRID CHINQUAPIN CHESTNUT LOADED WITH BURRS

It is about fifteen years ago that Dr. Van Fleet fertilized in his home place at Little Silver, N. J., the chestnut flowers with pollen from the chinquapin which gave rise to this hybrid plant and through these years its originator has seen and studied the offspring of the first cross dozens of times in the early mornings when no executive activities or "pressing engagements" disturbed his thoughts. (Fig. 5.)

A CORNER OF VAN FLEET'S PLANT BREEDING GARDEN

A miniature greenhouse, a tool and storage shed in which seed is threshed out with a flail or small mill and a lath shed under which tender seedlings and cuttings are protected from the sun, constitute the main equipment of the garden (Fig. 6).

once visited that great plant enthusiast John Rock, of Niles, Cal., and found his little office in the midst of a big nursery. I visited last winter the remarkable place of Doctor Nehrling, near Gotha, Florida, where those wonderful variegated Caladiums originate, and where hosts of other new plants are growing and being studied. There is that wonderful place of Chas. T. Simpson, at Little River, Fla., where, although little breeding is being done, thousands of new plants are being tested. The Marquis wheat, I was told by an old friend of the late Doctor Saunders, of Ottawa, originated in the Doctor's little garden quite near his house. One of the most fascinating places in all Canada I found to be the home of Mr. A. P. Stevenson, of Morden, where the Russian apples first succeeded and showed their possibilities for Canada.

Mr. T. A. Sharpe's place at Salmon Arm, B. C., has the fascination of an intimate plant breeding station.

The small branch station at Talent, Oregon, with its twenty acres of pears, is an ideal place, and it is in the quiet mornings in that charming little nursery that Doctor Reimer has discovered the blight resistance of the Chinese pear species, *P. ussuriensis* and *P. Calleryana.* Edward Simmonds, in our Plant Introduction Garden at Miami, working in the still mornings there, has produced remarkable hybrid annonas and selected and improved papayas. The striking work in the improvement of the Egyptian cotton which has made possible the extensive development of this crop in the Imperial Valley was done by Kearney, Cook and others in a little temporary field laboratory at Somerton, Arizona. Dr. Byron D. Halsted, of New Jersey, with whom I was associated for years, has been hampered always, it has seemed to me, by the fact that his plants and his laboratories were, until recent years, far apart, and he had to drag his specimens back and forth, and it

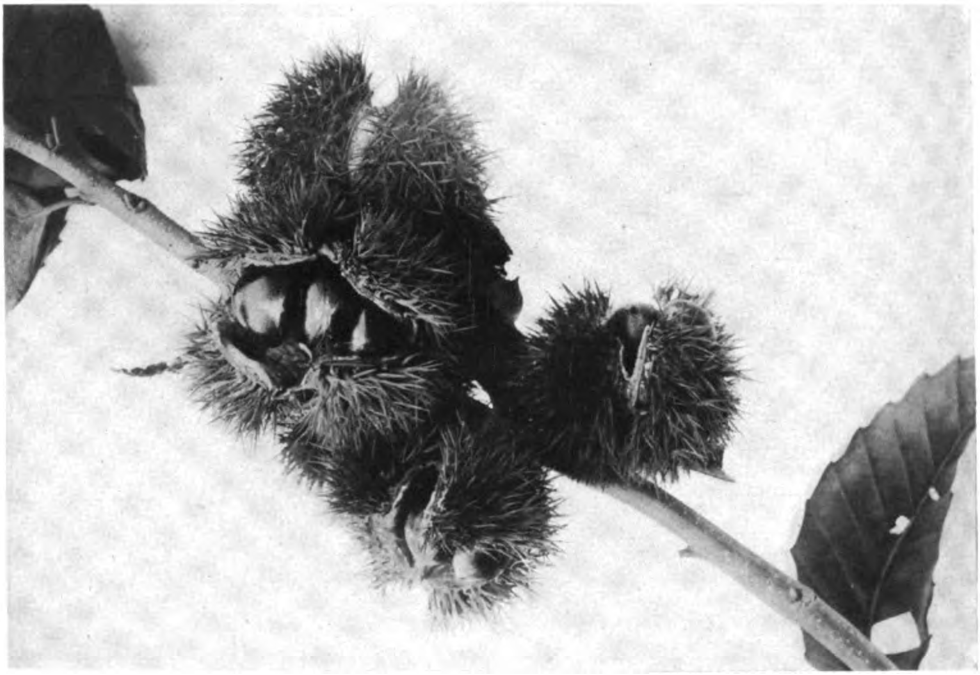
IDEAL SURROUNDINGS FOR THE PLANT BREEDER.

Dr. Walter Van Fleet standing beside his selected chestnut trees in his little plant breeding garden near Bell, Maryland. Eight acres of land are all he cultivates and he is able because he lives within a stone's throw of it to be among his plants when they are in flower before sunrise and before the bees have visited the blooms. (Fig. 7.)

required an expedition to get to his garden by daybreak. What charmed me when I first knew Luther Burbank was the fact that he had around his doorstep and in his backyard the plants he was breeding, and, that, weak physically as he was, he could work among his plants in the early morning before the people who came to see him were up. This was before the factory and publication bureau built a building and thoroughly commercialized his work. I wonder if he does not often look back to the quiet pleasure of those mornings.

OBSTACLES TO PLANT BREEDING

Sometimes it seems as though everything were against the plant breeder—every tendency in modern times. The commercial emoluments are few, for as soon as he tries to commercialize his new hybrid, he is obliged to develop a selling organization and has to step into quite another world—that of glowing exaggeration and the trials of employing many people, both of them activities which crowd out the time for concentration which the breeder requires, and, as they come in the spring, often interfere seriously with his breeding work. The result is he is generally tied up with some other organization, which, because of expense involved, gives him a room in a big building and a corner of some field used for other purposes; or, and this is even worse, he is put in charge of a botanic garden and a lot of professional gardeners, or an office full of busy clerks who insist on being directed, or a classroom full of boys who are interested in anything but plants and who delight in worrying the professor. The breeding work is a side issue, in any case—the teaching or directing or advising is what he is paid for. Yet how little the real breeder needs! A few acres of land, a skilled devoted man to help him, a little greenhouse and a place in the middle of his acres, where he can live and where he can quietly watch and get ready for the great occasion—the mating of two par-



ONE OF VAN FLEET'S CLUSTERED CHINQUAPIN HYBRIDS.

Produced by a cross made by Dr. Van Fleet on his home place at Little Silver, N. J.; an example of the fact that the plant breeder wants his plants growing close beside his house. (Fig. 8.)

ents, the offspring of which is to be propagated by buds or cuttings and later cover whole hillsides with superb fruit trees or by seed like the Marquis wheat and stretch away to the horizon—one level plain of perfect wheat heads.

I stood under a flowering spray of the Van Fleet rose last summer, and the president of the Rose Society said to me, "I am propagating a million plants of Van Fleet's roses this year. Van Fleet has produced some of the greatest climbing roses of this country."

It was my thought in writing this article that the readers of the Journal of Heredity might like to know that Doctor Van Fleet, the recognized breeder of roses has gathered a practical working collection of plants around him and in six years built up a place which should be an inspiration to any breeder and which illustrates what I am advocating, the establishment of such places by public agencies, wherever the individual plant enthusiast can be found who will utilize them and make them effective.

The Office of Foreign Seed and Plant Introduction can furnish the plants, the breeder can furnish the land, the government should provide the greenhouse and the labor and propagate and distribute the resulting hybrids to the commercial nurseries and proven cultivators of the country.

EARLIEST MAN[1]

A Speculation, Based on Achievements of Lower Animals as to How the Human Race May Have Made its Start—Importance of the Reproductive Instinct as a Source of all Progress—Fire Probably a Late Acquisition.

REVIEW OF A BOOK BY F. W. H. MIGEOD

WHAT were the habits of the earliest of our ancestors who can be called human? The question has often been answered by guesswork, but F. W. H. Migeod thinks it is possible to come a little closer to the facts, by considering what the lower animals do in a given situation, and then assuming that man's ancestors probably did somewhat the same. Mr. Migeod's little book is speculation, but it is interesting speculation, and much of it plausible.

The first step which set off from the bulk of the apes that line which afterward became man, Mr. Migeod ascribes to hybridization. This he believes would provide the new group with physical features which differed considerably from those of its parents, and also give it the chance to have more acquired intelligence than any other single species, since it would, to some extent, learn the acquired habits of both parental species.

Such a hypothetical form the author calls Pre-pithecanthropus. He supposes that by some cataclysm a part of this group was forced to leave its ancestral home and live under entirely novel conditions which afforded stimulus for mental development, as far as the brain of pre-pithecanthropus had any innate possibilities of development. "In the unfamiliarity of his surroundings fear strikes him everywhere, and all his wits are exercised in seeking safety from the real or imaginary dangers which beset him.

"Let us visualize this.

"Pre-pithecanthropus, unable to take refuge in trees (he is imagined to have been forced out of the forest by some geological change), hides in a cleft in the rocks. His mate and offspring crouch inside as far as they can crawl. In his terror at an attack by some carnivorous beast, he flings around his arms, clawing at everything within reach. A stone detaches itself in his grasp, and flies away from his swinging arms. An accidental hit, and his carnivorous pursuer turns and flees. The whole family are saved. Pre-pithecanthropus has done something he had never done before, and never thought of. It does not impress itself upon his brain, however, till he is hunted again, and then he learns to seek better hiding places, and that loose stones have a use.[2]

"It is in the defense of his offspring, therefore, that this creature, new in the world, began to develop his mental faculties. His cares in this respect were constant and prolonged, for with him his young were not cast off in a few weeks, or even months, to look after themselves. It was a case of years, or practically a lifetime, for the female would bear again before the previous progeny had reached maturity, and there would be not one but several offspring requiring the parental care. There was, therefore, a steady and uniform strain on the minds of both parents, but perhaps on the father more than the mother, as the latter would soon again be exercising all her maternal care on the succeeding progeny.

[1] Earliest Man, by Frederick William Hugh Migeod, F.R.A.I., etc., pp. 133. London, Kegan Paul, Trench, Trübner & Co., Ltd., 1916. "The book was written in the Gold Coast Colony, mostly while the author was living in a Bush station or traveling."

[2] In this connection it may be noted that both the gorilla and the orang-outang can wield sticks, and that baboons can throw stones very straight and roll rocks down a hillside.

"To the late arrival at maturity of the offspring, which might not take place until several others had successively put in an appearance, and to the the duty thus entailed on the parents of providing them with food and protecting them, may be ascribed the first incentive to the exercise of the mental faculties.

"From what has just been said it can be seen that the principal factor affecting the life history of earliest, and still scarcely recognizable, type of man is the length of time after birth before the young attain maturity. This is the beginning of family life and the social instinct.

"There is one characteristic in apes and monkeys of the present age which probably existed also in their progenitors, and which is perhaps more active in them than in any other species of animal. At any rate it seems to be so in captivity, no matter how long tamed. I refer to the spirit of destructiveness. It may be owing to an excess of physical acticity that this feature is so largely developed. So opposed is it to any such instinct as food-storage that it actually renders the latter unthinkable.

"This somewhat highly developed instinct of destructiveness must have taken a very long period to neutralize and restrain, and in consequence acted as a greatly retarding influence on rising mankind. In fact, from the intellectual point of view, but of course not from the physical, ants are far more fitted to be the progenitors of man than are some simian species. Not everything, however, in this world has depended or depends on intellect.

WHY PROTO-MAN BECAME CARNIVOROUS

"When first Proto-man had to leave a forest region, where alone there is an abundance of food the year round, of the kind he had been accustomed to, he would have to resort to the picking of grass seeds, or munching the leaves of such trees as were not deciduous, or else digging for roots. Failing that, he would have to become carnivorous, for part of the year at all events. That eventually carnivorous habits became common is amply proved by the remains found in the cave deposits. These are all in the temperate regions of the earth, and since none has hitherto been found in the tropics, it would seem to be a fact that whilst he rem ined in the tropics earliest man was purely vegetarian like his simian prede essors.

"The next move on the part of man's predecessors was the most important. It consisted in a move to regions less abundantly supplied with food, and where he had to exercise his wits to live. In time it developed into a period of hard struggle. We are now approaching the time when abundant relics of this stage of mankind are to be found.

"We must now try to visualize man as he was at the stage when he could first be called *Homo primigenius*. ortunately we have some remains to assist us. He appears as a hairy creature with skin of an uncertain brown color. In bodily size he approaches the average modern man as regards height, but with a longer body and shorter legs. The legs were bandied, and as a result the creature will have a wobbling walk. The arms will be long. The head will have small frontal development, but be large behind, and probably dolichocephalic. The nose will be flattened and broad at the base; the jaws of great power but the chin very receding. His eye will be black and small but piercing, and overhung with heavy bony ridges. Perhaps this description may recall a gorilla more than a man. Indeed in most ways he was not far removed from the former.

CLOTHING A LATE ACQUISITION

"He will be unclothed, and for a dwelling will seek a cave if in a mountainous country. Hills with caves are, however, the exception rather than the rule, and so for the most part his home will be beds of leaves or grass in the more inaccessible thickets, with rude shelters of roughly thrown-together branches. The absence of clothing will prevent his migration of his own free will into the more unfavorable regions to the northward, and it will not be until he has learned to make use of the skins of animals as a protection against

weather that he will wander far out of subtropical latitudes.

"It would at first sight seem to be a very simple matter to kill a fur-bearing animal and wear its skin. It must be borne in mind, however, that in the subtropical regions fur-bearing animals do not exist, or only at high altitudes. They are large and fierce animals, and so far man has not acquired the skill or understanding to make a dart or weapon to kill them with. If by some rare chance he did manage to kill one when attacked by it, he has next to skin it, and this is impossible without the equivalent of a knife, which he has not got yet. Then, too, he would want ashes to rub on the skin in order to preserve it, and he has not fire yet at the stage at which we are considering him. He must, therefore, have advanced considerably in the arts before he could clothe himself in the skins of wild beasts; in fact, he must be already well advanced in the stage of *Homo primigenius* before attaining to this stage of culture. Another point is that in the tropics and subtropics many of the animals are hairy, except those of the cat tribe. Certainly those that it would be easiest to kil' are hairy, and a rough, hairy skin would be no desideratum to wear.

"On the whole the cold would have to become very great before the need of clothing, if due to that cause, made itself felt. Man at that time was practically equal to the beasts in his ability to stand cold if the transition of the race into a cold region was not too rapid. We have the example of the Fuegians who are practically unclothed, or were until comparatively recent years, and, unlike proto-man, they are hairless. That cold was the cause of the adoption of clothing is, as we shall see later, most unlikely. It began first as a means of adornment, and it was not until it was practiced for that purpose that its extension as a means of protection came into use.

IMPLEMENTS PROBABLY UNKNOWN

"As to implements, proto-man would at first be without any, and would have no more knowledge of their possible use than such as he had derived from his simian predecessors who could throw stones and roll down rocks like the baboons of the present day, or use a stick spasmodically like the orang-outang or gorilla.

"The manner in which he would make use of a stick at first is somewhat uncertain. As a thing to be thrown, we can of course accept its use, but that he would systematically take a stick about with him is unlikely. He would be too irresponsible for that. If he were attacked, or wanted to attack, he might break one off and make use of it, only to drop it immediately afterwards. Man was still at this stage without thought for the future, and certainly would not take a stick out in the morning when starting off to feed, as some drawings made of early man in recent years would seem to suggest. It would only be an encumbrance, and to accept an encumbrance with a view to future contingencies becomes a sort of insurance, implying an enormous advance in forethought, and taking a measure of the future. The use of a stick would, therefore, be on the spur of the moment, and chiefly to throw. In the ordinary course of life he certainly would not be bothered with a walking-stick. It would, besides, imply ownership, and we have not shown him as owning anything yet.

OWNERSHIP AN IMPORTANT FACTOR

"As ownership is an important factor in man's development, being the beginning of capitalization, without which there can be no progress, we may here stop to consider what nature of things man was first likely to collect or desire to have by him, once used to be used again.

"It is possible that utility will not have been the first consideration in this respect. Rather it will have been things that please the eye.

"He has already the faculty of bringing home things in the nature of food supplies for his young. If he meets some striking object, such as a brilliantly colored pebble, it is likely that with his dawning intelligence he will pick it up and take it home as a matter of curiosity. To pick it up, and look at it, or lick it,

and drop it again, is possible and may happen countless times, until one individual, not forgetting his family at home to whom he is carrying food, will take the strange new thing with him. Indeed some birds will carry off bright objects, mentioning which we may recall the celebrated jackdaw of Rheims.

"On another day he has picked the vivid-hued feather of some gorgeous tropical bird. He looks at it, and takes it home stuck in his hair for convenience of carrying. On his arrival it at once strikes the eye of his wife and children. Signs of pleasure are expressed. His vanity is flattered, and here we have man beginning to adorn his person.

"In reviewing the possible circumstances attending the daily life of proto-man . . . and considering his few requirements and small metal activity, we may perhaps assume that it was in connection with his food that the first use of an implement took place.

"Let us take a nut too hard for him to crack with his jaws, and banging it down is also without effect. His next act is to take a stone and crush it. Yet there is no originality here, since monkeys in captivity have been observed to do the same, and, further, to hide the stone for future use. The only point we need therefore note in this connection is that stones can readily have come into common use for such a purpose with earliest man, who is now acquiring greater intelligence.

"The next stage that may be considered is the additional use of stones for producing music or noise. It is said that a gorilla practices a sort of music by beating trees with a stick in addition to striking his chest for the sake of hearing the resounding noise. There is therefore the association of striking with pleasant sounds. Proto-man similarly found out early, even if his progenitors had not already done so, that stones could make a pleasant rattling sound when thrown on a rock, and could render the noise as pleasing as he liked by merely adding to their number.

"Man has, therefore, to sum up, turned to the rough stones which he can pick up anywhere for his first implement. Three uses are established: that of throwing when attacked; for throwing and hearing them resound, and for breaking up hard nuts, with a hint of a grinding motion.

"In addition to the use of a stone implement, he has acquired some idea of personal adornment and a rudimentary idea of music as well. These mean that both his eye and ear can receive impressions of other than a purely utilitarian nature. His taste for new foods is, however, undeveloped, and only forced on him by necessity, owing to failure of something to which he is accustomed. Unclothed, and still with only the rudest form of shelter, he lives a family life, and the new generation as it becomes adult tends to separate and form new families which move farther afield in search of new food supplies.

THE DAWN OF ART

"As far as we have reached in the course of his evolution man has not advanced beyond the stage of making an uncertain and spasmodic use of a few objects in their natural state. We must now make an endeavor to think out how he could have begun to work on some of these natural objects so as to adapt them to a specific purpose which he may have had, necessarily in a vague sort of way, in his own head.

"The assumption may be made and adhered to that it was on stones that earliest man first exercised his handicraft. Nevertheless between using any stone that came to hand in order to crack a nut on a rock, and breaking it or chipping it for a specific use, lies an enormous gulf, and this we must endeavor to bridge.

"As a possible hypothesis, what may have happened is that a certain Proto-man whilst digging for roots with his bare hands, met some obstructing stones. These, like monkeys of the present day, he would pull out and throw aside. Early man, though, has already a dawning intelligence, and is, as we have shown, not unfamiilar with handling stones. As he burrows, he comes on a stone that scrapes the skin off his fingers. He grips—and, instead of throwing it away, still grips it, and goes on burrowing.

"He has learned that a stone helps him to dig. Later he finds he can burrow more quickly or more easily with some stones than with others. Some really impede him. He cannot get on with them at all. So gradually he gets to know the kind best suited to his use.

"Then at last the miracle comes. It dawns on his feeble intelligence that a broken and sharp stone is better suited to his purpose than a smooth one, and that he can produce such a stone as he requires by breaking a big one. One individual alone has found this out, and the others make use of his discovery, which is that if a broken stone cannot be found, they must break one for themselves."

Such stones, broken in greater or less amount, are found in many places, and called eoliths. "It was at the age of eoliths that man's wider dispersal began, and according to the evidence furnished by the distribution of eoliths a big wave spread in the direction of northwestern Europe. In what other directions the spread took place has yet to be found out. It awaits further excavations on an adequate scale in other parts of the world."

USE OF FIRE OF VAST IMPORTANCE

It is by this time necessary that man should have acquired knowledge of how to use fire; and he may have learned this from either lightning or volcanic fire.

"Earliest man, like the beasts of the field, must have been for long ages accustomed to fire before it ever dawned upon any one individual to try to make use of it. Their intellects had not hitherto led them to that. It was universally regarded as an object of fear to be fled from to save their lives. As a great conflagration died down, some of the more inquisitive animals such as apes and monkeys may have gone to the extent of warming themselves by some smouldering tree after being chilled by a sudden storm of rain. Early man may even in times of dearth have tasted and eaten the roasted remains of some small animal that failed to escape the fire in its advance. It must, however, be here noted that as a matter of fact bush fires advance very slowly, certainly in the grass country of Africa, and not on a very broad front. For any animal to be caught and burnt is therefore an exceedingly rare occurrence.

"From such tentative uses of fire nothing could have resulted unless man had already acquired the mental capacity to make use of external material. No improvement has resulted from the acquaintance of animals with fire. Even the intelligent dog, who is always with man, and thoroughly understands the warming properties of fire, makes no attempt to further utilize it, and has not the least capacity to make it up when it sinks. It was not until, in the course of ages, man with an intellect capable of developing, had acquired the use of one art after another, if only in a small way, that he was sufficiently advanced to recognize the properties of fire; and it must, of course, be recognized that in his mental development every addition to the list of arts would react on his mind and predispose it to further efforts.

"As to the first stage, we have already seen that he may have met in the track of a grass fire the body of some animal that had failed to escape and been burnt to death. Having tasted it in the possibly ensuing dearth, and having found it good, the attention of others may have been drawn to it, and they too ate it with appreciation. This appreciation may take a dual form. The vegetable food supplies on which they relied may have been burnt up to a greater extent than usual, and so the zest of hunger would be brought to the newly found food, besides its being liked for itself alone as an occasional dainty. As regards the question of the possibility of a change of food being adopted, we have only to remember the remarks made earlier about the Kea parrot of New Zealand when such possibilities were discussed."[3]

Man might catch something for him-

[3] As one of the best authenticated examples of how the lower living forms can change their diet may be quoted the Kea parrot (*Nestor notabilis*) of New Zealand. Like other parrots this species was formerly purely vegetarian. In the middle of the nineteenth century, however, the English settlers introduced sheep. Apparently a time of scarcity of the parrot's own food came,

self and roast it in some smouldering tree, but he could only do this when a fire had appeared naturally. "For the next stage in the development of the use of fire by man, we must go back to the chance fire brand brought home. One day such a one was carried back. Hitherto all had died out in a brief space of time, and that same evening saw them cold and black. On one occasion one was still glowing next day. A faint breeze fanned the place where it lay, or it lay close to another stick, and the spark did not die out. This was a phenomenon and a source of wonder, It was a new discovery and, many inventions being due to accidents, we may even imagine a fire-stick setting light to the heaps of dry leaves on which they slept, causing a hasty and alarmed retreat.

"It was the fire-stick burning until next day that undoubtedly made the impression on the mind of some one individual of the race of earliest man that there were ulterior possibilities. It was he who first discerned that some sticks burned longer than others. Perhaps it was on some other individual that the perception dawned that with a faint breeze to fan it, it held fire longer than another stick less favorably placed.

"Even with these phases duly recognized, a strong mental impulse is still necessary for such individuals to make use of them, and so secure the life of the fire. This can only be effected by adding more fuel; and it would further require an individual advanced yet a little beyond the others to think that if one stick unkindled be joined to another alight, it will catch the fire and can pass it on to yet another stick. All these processes are simple and obvious to us at the present day, but we may be sure that in the early stages of mankind they were reached only after long successive periods. This means that man played with fire long before he possessed it not to lose it again. We should still be without fire at the present day had not one of our progenitors succeeded, more by accident than by design, in keeping a fire smouldering for a lengthy period. It may be a heap of leaves was set alight and continued smouldering; or a wind-driven or water-borne accumulation of gases; or a tree-stump which held the germ of fire and lasted out for days, if not weeks. Any one of these would serve as a source from which fresh supplies of fire would be drawn as needed.

POWER OF IMITATION STRONG

"With the power of imitation that is almost an instinct with primitive man, either at the present day or when all mankind was primitive, some one individual would do what nature had done, and once done and a repetition of the act being accomplished, the power to do so again would forthwith become common property, at least in a restricted circle or in a particular locality. They would cherish it carefully and hand it down to their descendants, and any human beings outside their own home or tribal circle would only acquire the same with difficulty from the owners, probably by force or theft. It would scarcely be by favor, for at this early age we may presume that the moral idea of favor would be unknown. The possessors of such a valuable acquisition as fire, keeping it to themselves, would soon advance rapidly beyond their neighbors. The latter, unless united with them or absorbed into what has become practically a superior race, would remain behind in the general intellectual advance of at least a portion of mankind; and, if they did not die out, would only survive as an indication to later ages of how their progenitors existed in prehistoric times.

"The duration of the stone age covers by far the greater portion of the time of

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and this bird at once developed carnivorous instincts, and of a nature distinctly surprising. At first it began to feed on the offal of sheep from the slaughter houses, but later turned to the living animals, chiefly the lambs, attacking them on the back to get at and devour the kidney-fat, the death of the animal attacked being of course the result. The whole of the parrots of New Zealand could not have, in a single day as it were, decided on a new line of feeding, and have all set out together on a new career of flesh-eating. One single bird, driven by the stress of hunger, must have made the first attempt, and have communicated to others that sheep-flesh was agreeable; so that the rest of the parrots of this species lost no time in becoming meat-eaters, and meat-eaters of a very refined and specialized order.

man's existence on the earth. . . . In the beginning, when man first seized a stone to help him get through some hard or stony ground in burrowing for roots, he was scarcely out of the purely simian stage. His brain was small, the fore-part undeveloped, and his jaws massive. Long before the end of the stone age, indeed before the end of the paleolithic age, he emerges a complete man, the true *Homo sapiens*."

The paleolithic age marks the time when man acquired added skill in making stone implements. Many other rude arts, such as pottery and weaving, must have been acquired at about this time, Mr. Migeod thinks. It was a period of rapid mental development: "This would entail his power of speech developing too. When at length the end of the paleolithic age came, it may be accepted that man's speech was sufficiently developed to be recognizable as the speech of *Homo sapiens* as it might be at the present day among the less advanced people of the earth who are without a literature.

"That this is so is shown unmistakably by the advanced stage of all the arts at the end of the paleolithic age in Europe. All the then existing arts indicate co-operation and a multitude of social activities. None of them could have had their existence without a ready means of vocal communication; and terms would already have been invented that would cover every conceivable subject in the sphere of man's comprehension in those ages.

"Eolithic man was left behind as scarcely a true man yet. He was at best *Homo primigenius*, not *Homo sapiens*. During the paleolithic age he became the latter.

HOW SPEECH BEGAN

"It will be useful to consider what can have been the primary moving cause of the production of speech. This is, in the writer's opinion, the same as that which has originated the arts, and that is the instinct inherent in all living things, whether of the animal or vegetable world, to propagate their species.

"It is this instinct that makes plant life one season of the year put on its most vivid dress. It is this same instinct which makes living things do the same. At the breeding season male birds put on their most brilliant and gorgeous plumage. Various animals, too, have given to them some change in their appearance. It is at the spring, or corresponding period of the year according to the latitude, that this new energy pervades the world. Animals which at other times of the year have no instinct except to feed themselves, at this particular season develop new faculties. Some birds know all at once how to build the most elaborate nests for the expected new generation. Many animals begin to look for comfortable homes where their young can be reared in safety; and, above all, their voices are heard as they are heard at no other season of the year.

"Now what is the nature of the sounds that come from all these birds and animals? There is a school of thought that tries to reduce all human speech to original roots, and to find a minimum of basal roots that they can point to as the first beginnings of human speech. It would seem, however, that there is something wrong there and out of harmony with the observed facts relating to animal life in general, and to simians in particular. One hears monosyllabic utterances, if such they can be called, proceeding from animals, it is true. Much more commonly it is a complex or polysyllabic sound, largely influenced by tones. Monosyllabic sounds cannot, of course, be absent, for the simple reason that if there are sounds of two or three syllables it is hard not to conceive a monosyllable possible. Such monosyllables are interjections or commands, and are entirely non-descriptive, such as may be the multiple utterances of which so many animals are capable. As to what these multiple sounds mean, man has, of course, but little means of knowing, any more than he knows a strange language on first hearing it. The fact remains, however, that one or more ideas are conveyed to another being of the same species. The unit of predicative speech is therefore a compound or multiple utterance, or in other words a complete phrase.

"It may perhaps be assumed that cries to his mate would be the first form

of voluntary utterance by a sentient being, and cries of pain or distress the first involuntary ones. . . . To cries of the first nature might be added in turn cries indicative of pleasure. These latter would be largely personal."

After self has been recognized, the outside world would be taken into cognizance. Food will be an important subject; hence means of expressing the relative position of place would take precedence of time.

In all man's progress, Mr. Migeod ascribes an important place to geologic changes, which kept him moving and gave a new environment, which called forth and selected new attributes of his mind. "This steady movement brought higher races into contact with lower races. If sufficiently numerous or powerful in proportion they absorbed or destroyed them. If they did not succeed in maintaining their superiority, they themselves were liable to degenerate. So the reaction one on the other has ever continued, till at the present day, we find the highest evolved type meeting the fragmentary remains of unprogressive types of earliest pre-humanity, and in the shape of gorillas and orang-outangs treating them as wild beasts to be destroyed when met with."

Additional Facilities for Army Medical Museum Needed

Urging the importance of additional facilities for the Army Medical Museum, Major R. W. Shufeldt in the *Medical Record* of October 20, 1917, states some striking facts regarding the heavy burden of work which is placed on the Museum by the entrance of the United States into the world war, the invaluable aid to all scientific work which it will do if facilities are provided, and the entire inadequateness of present equipment.

Early in the Civil War, steps were taken to collect together material of every description relating to military practice of medicine and surgery, consisting of specimens collected at post mortems and all kinds of military equipment. This material was housed in the old Ford's Theater on Tenth Street. To the specimens were added all the field reports and special histories of the great combat. Although it was soon seen that Ford's Theater was entirely inadequate to house the valuable material, nothing was done until a floor collapsed and several clerks were killed or injured. The government then supplied the present building.

This collection of enormous value is already vastly too large to be housed in the present building, which as Major Shufeldt points out has been for years a supreme joke. Since entirely different methods are now being used from those of the Civil War, a new museum of vast capacity to house the materials which will soon come flowing in in a huge stream is an urgent necessity. All this will require appropriations by Congress for a new building and adequate equipment to be placed under Colonel Owen's control.

War Makes Large Demands upon Horse Breeders

That the steady drain of horses and mules to the war fronts will cause a great scarcity of animals after the war is the opinion of the *American Red Star Animal Relief*. Whatever surplus America may have had is likely to dwindle before the Allied nations have satisfied their needs. From many breeders comes the advice that every good mare should be bred during 1918, in order that America may be in a position after the war to restock Europe.

Losses in the U. S. Army alone during the period of six weeks ending January 12, 1918, amounted to 4,777 horses and mules, which represented, at an average purchase price of $175 each an expenditure of $835,975. A great proportion of these deaths resulted from influenza or "shipping fever." Up to the present time no satisfactory treatment or preventive inoculation has been devised for this disease.

Since the beginning of the war, the animal strength of the U. S. Army has been increased from 66,145 to 344,000, the War Department has announced.

DECADENCE OF HORSE BREEDING

Impending Crisis in Whole Breeding Industry—Imperfections Found in Present License Laws—Differences between Congenital and Acquired Defects not Always Made Plain—Unsound Mares a Menace—Actual Breeding Test often Contradicts Theoretical Forecasts

HENRY M. JONES, *Lexington, Ky.*

THE article "Better Horses" in the November JOURNAL is most pertinent, coming as it does at an impending crisis in the whole breeding industry. However, the writer wishes to enter a protest against the license system as a means of eliminating congenital defects or undesirable blood lines. The license laws that I have examined do not prohibit the use of either defective or scrub sires but merely require that all unsoundness, either congenital or acquired, be made public. Further, these laws do not prohibit the use of unsound mares for breeding. It is true that a congenitally unsound mare produces but one foal in a year, still that foal may be a stud and be a greater detriment to the breed than the older horse. In the first place, none of these laws define congenital unsoundness nor do they prescribe any test by which congenital defects can be separated from acquired. A congenital defect exists at birth. Biologically, this is the only defect that can be transmitted. It is unthinkable that any breeder would keep entire a colt that was foaled blind, or with any other of the numerous unsoundnesses that these laws class as congenital. There is but one test of any congenital character, and that is the "actual breeding test." It may be well to refer to the history of some noted stallions that would have been placed under the ban by these laws.

NOTED THOROUGHBRED BLIND

The noted thoroughbred stallion "Lexington" was blind through the greater part of his stud career. Yet he founded one of the greatest families ever known, not one of which inherited weak eyes. The most prominent living thoroughbred sire is blind. Yet he has never sired a blind colt and his produce are selling for higher prices than any other sire.

Two of the most noted living trotting sires would be branded as congenitally unsound, as one has a bog spavin and the other is string halt; and yet each has sired champions and founded families that are as free from this unsoundness as any other family. It is not invidious to mention the names of the noted sires now dead, that were blind. Especially is this the case as the present writer bred to each of them and now has their blood and factors for unsoundness (?) incorporated in his greatest brood mares, line bred and inbred, for four generations, and yet has never had a blind foal or a horse with weak eyes, although some of them reached the age of twenty-five years. The stallions referred to were Simmons, Wilkes Boy, Jay Bird and Eagle Bird—all of which were blind, yet the large families left by each of them are as free from blindness as other sons of the immortal George Wilkes who were more fortunate. If these horses were congenitally unsound, the factor must have been transmitted by their sire George Wilkes or by the dam's family—which was by Mambrino Patchen.

ACTUAL BREEDING REAL TEST

To publish to the world that these two greatest of all progenitors of trotting speed transmitted factors for blindness is to condemn the best families of the trotting breed. To this breeders will not willingly submit nor will they submit to their life work being stigmatized by theoretical laws when the "actual breeding test" disproves their efficacy. The

A NEW YORK STREET BEFORE THE ADVENT OF THE AUTO

Prior to the advent of the automobile, those horses which did not prove to be winners in the racing game found a ready market for work such as that pictured above. Mere lack of extreme speed did not impair an animal's value for such a use, and there was sufficient demand for good sound horses to utilize all the surplus from the race-track. Photograph by Underwood & Underwood. (Fig. 9.)

writer yields to no man in appreciation of the forces of heredity, for in early youth, when scarcely able to understand biological problems, "Origin of Species" was a nightly study, and from then to the present day the best authorities are constantly on hand. With information thus gained, and thirty-five years of practical experience in breeding, we do not feel the need of legislation to protect us, nor would we change the selection of blood lines for future mating under any conditions.

RECOGNITION OF RACING DEMANDED

As for protection from congenital unsoundness, the experienced breeders judgment is a greater safeguard than any legislation, and as protection against false blood lines the register has long since eliminated the chance of fraud and no breeder of either standard or thoroughbred horses could be induced to patronize a stallion that was not registered. (However, there are many inexperienced breeders who are not sure of their ground. The greatest breeding is that of draft horses, as may be seen by the records of the states having laws.—The Editor.) The protection breeders need is the recognition of racing by the Government as a legitimate business, for racing is now the only incentive to breed. But, with only one state having legalized racing and existing by sufferance in all others, the breeding industry is on a most unstable foundation. Each new legislature has some members who for gain, politically or financially, attempt to introduce adverse legislation. The report now comes from Maryland that the lower house of the 1918 legislature will be solidly against racing in any form in that state. The Detroit Driving Club, which for many years has been one of the leading associations of the Grand Circuit and has made two stakes classics, which has given to the winner a high value either for breeding or racing, has had to quit on account of adverse legislation. When the Hart-Agnew law was passed in New York it cost the State of Kentucky alone $5,000,000. The great breeding establishments were compelled to ship mares to South America, Australia, France and other foreign countries to find sale for them at any price. After Kentucky placed racing under a State Commission, some few have continued breeding, but to-day the production is not one-third of what it was formerly.

The breeders of the trotting horse are facing conditions that are unique in a way and have been brought about by the force of two factors, one of which could not be controlled; the other could. Prior to the advent of the motor, horses unsuitable for racing found a ready market for the road. Those of exceptional conformation were educated for roadster classes in the show ring or for the three gaited saddle class. But the motor has practically eliminated road driving and no other outlet has been found for this class of horses. In fact, the trotter now occupies the same position as the thoroughbred, distinctly a racing tool, but races under the worst system that could be devised. If not a stake horse his value is less than the cost of production, as he has little, if any, earning capacity. If of stake caliber, he acquires a fast record, then he is worthless for racing purposes as the associations do not offer purses of sufficient value for him to win more than expenses. Quite anomalous situation, the greatest merit the less value.

END THOUGHT DRAWING NEAR

This class of horse formerly found a market in Austria, Russia, Italy and other foreign countries, but the war has closed this outlet. The breeders, besieged on one side by the ever increasing use of the motor which cannot be controlled, and on the other by racing conditions that give value only to the exceptional horse, find no means of escape but to quit breeding. Only a few years ago any road that led from Lexington would reach the stock farms of several breeders, each equipped with a track and complete training plant; to-day there are four breeding farms in Kentucky and the farmers, who formerly kept six to ten good brood mares, have in the majority of cases sold them. A very few have kept one or two through sentiment, but farm them or breed on shares, and in every instance sell the foal to the

HORSELESS FIFTH AVENUE TODAY

Now that the motor driven vehicle has been proven successful along every line, the horse is being rapidly displaced from his former position as an indispensable assistant. This has almost closed the outlet for surplus race horses, and as conditions now stand, horse breeding is in many ways a losing game. The amount of land required as pasturage for one horse would pay a much larger increase on the investment if used for raising tobacco. Photograph by Underwood & Underwood. (Fig. 10.)

owner of the stallion at any price he may name. Not one of them is reserving fillies for future brood mares, and when the present brood mare holdings pass away or become barren, finis will be written.

The writer has handled stallions for many years and now has one of the most prominent stallions of the trotting breed and is intimately acquainted with breeders and owners of stallions throughout the U. S. and finds that what is true of Kentucky is true of every section where stallions are kept. The present decadence in breeding is not such as has been caused by financial panics, when breeders curtail operations for a while and reduce the brood mare ranks. In fact, these periodical reductions have been an advantage as it caused a weeding out of the lower class, reducing the number of foals but greatly improving quality. Our government, as is well known, is far behind foreign governments in encouraging improvement in stock breeding. In fact, even the state laws have thrown serious obstacles in the way. Kentucky has a license tax of one service fee instead of a bonus and the assessor never fails to raise the value to the limit. In Virginia a noted stallion was assessed at $50,000 and when sold at public auction only brought $30,000, quite discouraging to the owner who had invested close to a million dollars in Virginia land.

FAULTS OF PRESENT PLAN

The consensus of opinion among many breeders is that the present plan of the Government to improve horses by the use of its stallions upon grade and scrub mares cannot be entirely successful. It might be more practical to buy at the various auctions pure bred mares, placing them in the hands of farmers, requiring them to sell the geldings to the government at not less than $200 and keep the fillies to be bred at three years of age under the same contract. In this way breed improvement would be sure as grading is worthless in the second generation. (But a mare may have but one offspring a year while a stallion may have fifty. It is for this reason that it is of paramonnt importance to see that only pure bred stallions are used.—The Editor.) Under state aid it is only a matter of a few years when every county seat will be connected by roads of easy grade, and as smooth as an asphalt street. Every mile of such road increases the use of motor power and decreases the use of horse power proportionately. Particularly is this the case in the mountainous section of the country where coal and lumber are abundant and the horse has been used exclusively.

As stated, racing is now the only incentive to continue breeding, but conditions controlling trotting races are so arbitrary that the exceptional horse can win through the entire circuit without incurring a handicap until the following season.

There is no question that two- and three-year-old colts that can trot in 2:08 to 2:10 are high class, yet they cannot now earn expenses in the colt stakes as they have to compete with colts that can trot in 2:04 or better throughout the entire racing season. Such colts have no earning capacity and represent a far greater percentage of the breeder's product than the exceptional colt and yet cannot be sold for cost of production. This is the most discouraging feature of breeding and is the chief factor of the decadence of breeding the trotter. This could be easily changed if racing associations were controlled by either state or government commissions that would foster the breeding interest and at the same time not impose burdensome conditions upon racing associations. This is the most opportune time to place all racing, from the largest association down to the county fair, under a government commission. Such a commission should be composed of breeders and promoters of racing and should have the power to make and enforce all laws governing racing and speculation. Unless some such safeguard is found in the very near future, an industry which is wholly American will become extinct. The trotter originated in America and nowhere on earth has his equal been found, as no other breed of domestic animals has ever withstood the adverse conditions as long as this breed, but at

last has become a supplicant for its existence.

HORSE BREEDING AT LOW EBB

Economical conditions counted with the war would seem to be the final stroke to the decadence of breeding horses. It is estimated that 4 acres of the best land is required to pasture one horse during the grazing season, that is from April to December; then the expense of feeding during the winter additional. This class of land planted to tobacco will now yield a net profit of $200 per acre, to hemp $150. In fact such land readily rents for these crops at $50 to $75 per acre. These crops are matured and marketed in eight months, whereas the horse must be three years old before the Government will pay $150 for him, and then must be sound and of good conformation. Land that nets in tobacco $200 per acre for three years would figure the cost of each three-year-old $2,400 for grazing only, that is, the land required to produce one three-year old would net the owner $2,400. Consequently the only chance of profit in breeding is to produce the exceptional horse that will bring more than this amount. Unfortunately the pure bred animals have not reached that state of perfection where predictions are fulfilled with sufficient constancy to reduce the percentage of by-product to a point where profit can be made.

STEPS TAKEN IN CANADA

Canada has begun to eliminate horse breeding, to take up breeding of dairy stock. In fact, any other agricultural pursuit now promises more than horse breeding. This is no idle carping of disgruntled breeders, but plain facts stated far less forcefully than conditions demand. It is rather an appeal of patriotism to save one of the most efficient aids to win this horrible war and an indispensable necessity in peace.

Inheritance of Diathesis through Five Generations

An interesting addition is made to cases where a tendency toward disease seems to be definitely inherited by the report of Drs. Joseph R. and Thomas R. Crowder in *Archives of Internal Medicine* of angioneurotic edema occurring through five generations. The disease is characterized by transient local swellings in various parts of the body, generally accompanied by gastro-intestinal disturbances. The etiology is obscure.

About 1820, being a young man and recently married, J. C., took a contract in a logging camp of Pennsylvania. He had an attack of illness which was believed to be quinsy, in which the neck was greatly swollen. From that time on, the swellings were repeated at various intervals, invading all parts of the body, and proved fatal through the involvement of the throat twenty years after the first attack. Previous to his attack in the logging camps, he had never suffered any such malady, and there was no record of such trouble in his family or relatives.

This man was father of ten children, all but one son were afflicted with this peculiar malady and seven of them died from its effects. Seven members of this generation left children aggregating twenty-nine, and of these, twelve were afflicted. In only one of the seven groups of children were all the children free from the disease. In the fourth generation there were seven groups of children comprising eighteen children. Nine of these are descended from affected parents of whom five have the disease. The nine descended from unaffected parents are all free. The fifth generation contains up to the present time only six members. Three are daughters of an unaffected mother and are all free from the disease. Three others are the daughters of an affected mother and only one of those has so far shown any taint.

A NEW SCIENTIFIC JOURNAL

American Journal of Physical Anthropology to be Established in Near Future—Dr. Ales Hrdlicka of National Museum Is Editor and Founder—Scope Will Include Every Phase of Modern Physical Anthropology

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IN THE history of the development of every branch of science there comes a time when the establishment of a medium of publication devoted to that particular branch of research is essential to its full development. It is a peculiar and regrettable circumstance that physical anthropology has remained thus far without adequate facilities of publication and without a journal of its own in this country, the richest in the world in the subject-matter of that science. Notwithstanding the fact that most European countries, including even Portugal and Switzerland, have each from one to three journals devoted exclusively or largely to physical anthropology, and that some of these have been published continuously for more than half a century, no effort has yet been made on the American continent toward the establishment of such a periodical. It is true that we have the *American Anthropologist*, but that journal is devoted to anthropology in its broadest sense, and its pages are practically pre-empted by the more popular branches.

It is urgently demanded that these conditions be remedied and that a journal devoted to the interests of physical anthropology be established. The time is ripe and the opportunities for development are unsurpassed. The war has now involved this country as it involves practically the whole white race, and the unprecedented conditions that have arisen in consequence bring forth a legion of new anhropological problems, as well as exceptional opportunities for research.

The proposal to establish a periodical devoted exclusively to physical anthropology has been presented successively to the Subcommittee on Anthropology of the American Association for the Advancement of Science, the Committee of One Hundred on Research of the same organization, the American Anthropological Association, the Smithsonian Institution, and the Committee on Anthropology of the National Research Council, by all of which it has received unqualified approval.

More than mere approval, however, is required. Energetic promotion is demanded and financial considerations insist on presenting themselves. The establishment of a scientific journal that cannot expect a large circulation calls for means by which the periodical may be supported for a period of years or until its income from subscriptions equals the expense of publication. Careful estimates indicate that aid to the extent of **$1,000** a year for three years would insure the publication beyond question; and it is proposed to make an especial appeal for this support, an appeal which must be largely to individuals, since institutions generally find their rules and regulations a serious obstacle to the devotion of funds to the promotion of a periodical not issued under their direct auspices.

Thus so much for the reasons which have actuated the founder, Dr. Ales Hrdlicka, Curator of Anthropology of the National Museum, in undertaking at this critical period, the publication of the *American Journal of Physical Anthropology*, and for its first needs. Application to his colleagues for editorial assistance has met with the most encouraging response, and there is substantial hope that adequate aid will be given by devotees of the subject toward developing the *Journal* and making it of substantial scientific and public utility.

The *Journal* will probably appear in April and will include research and special articles on man's origin, development, variation and present status, everything of anthropological interest connected with the war; descriptions of American collections, their field work, installation and exhibits; the objects, history and methods of anthropometry in general; reviews and bibliography and anthropological news and notices of current interest.

FAMILIES OF SIX GENERATIONS

Two Examples of Early Marriage and Child-Bearing, with Extreme Longevity—Transmission in Both Cases Through Females—Few Similar Authentic Cases on Record

FAMILIES of six living generations are found so infrequently that the two cases reported by Dr. George M. Gould are of more than usual interest.[1] Although cases of extreme longevity, and families of even as many as seven living generations, are reported from time to time as occurring as far back as the seventeenth century, modern methods of keeping vital statistics have shown that such reports were without doubt highly exaggerated. The two photographs published herewith, however, were both taken in September, 1908, and the cases are for this reason well authenticated. Both families are well known in their communities and their striking records are well vouched for.

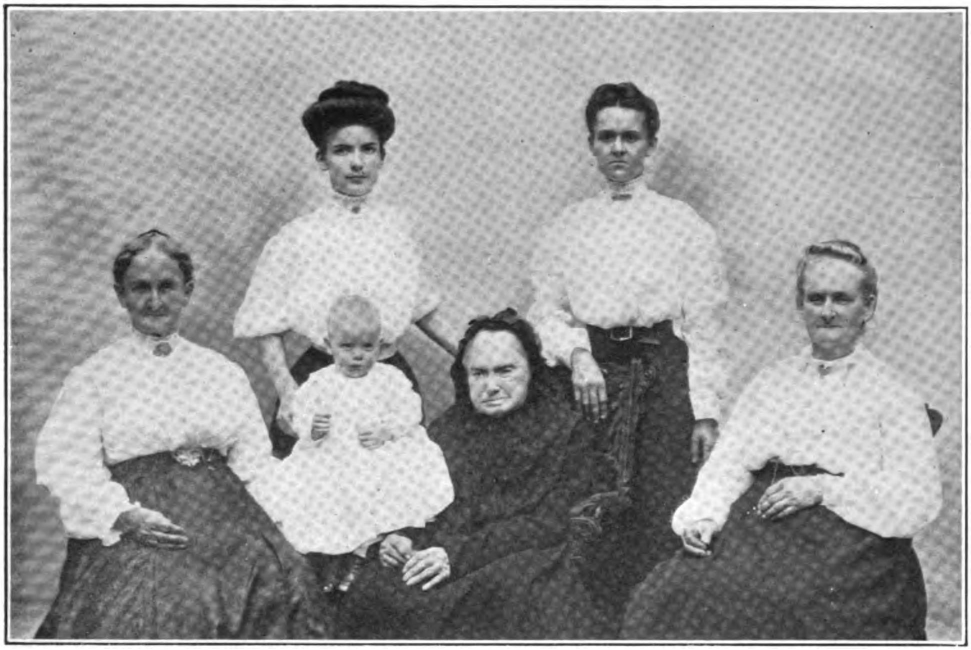
AN UNUSUAL CASE

The first of these twentieth century cases is the Shrake family, of which

SIX LIVING GENERATIONS

Although families of four living generations are quite commonly found and an occasional report tells of five generations, groups such as the above, including members of six living generations, are exceedingly rare. Other things being equal, the chances of a long life are greater for this babe in arms than for the child born of parents whose own parents have already passed away. Photograph by courtesy of Dr. George M. Gould and *American Medicine*. (Fig. 11.)

[1] Dr. George M. Gould, *American Medicine*, September, 1917.



DESCENDANTS IN FIVE GENERATIONS

Equaling the achievements of the Shrake Family, the Passes present another peculiar case where longevity combined with early marriage and child bearing produced six living generations. It is peculiar that in both these instances, the transmission was entirely through the mothers. Photograph by courtesy of Dr. George M. Gould and *American Medicine* (Fig. 12.)

Mrs. Lydia Thomas Ault Shrake was the oldest living member. The following details have been gleaned from newspapers, family letters, and fellow citizens and acquaintances of the family who were residents of Wyalusing, Grant County, Wisconsin, about five years before the death of Mrs. Shrake.

Mrs. Lydia Thomas Ault Shrake was born in Cornelsville, Pennsylvania, in 1814. At the age of eighteen she married William Ault. Five children were born. Mr. Ault died in 1839, and two years later Mrs. Ault married Jacob Shrake. Again five children were born. "Grandma Shrake" sent five sons to fight in the Civil War.

Margaret Ault Elder was born in 1835 and married at the age of fifteen, and, at the date of this quoted report had borne ten children, seven of whom were living.

Rachel Elder Goff was born in 1851 and married at the age of seventeen. She was the mother of twelve children, seven of whom were living at the time of the report sent to me.

Melissa Goff Spaulding, born in 1873, married at fifteen, became the mother of three living children.

Cora Spaulding Gulley was born 1891, married at the age of fifteen, and had one child.

Agnes Elder Goff Spaulding Gulley was born August 5, 1908.

COMPETITION BETWEEN FAMILIES

Mr. Brookens of Bloomington, Wisconsin, wrote in 1909 that he photographed five generations of the Cooley family, "the eldest lady in this case being about ninety years old." "It was a tie between the Shrakes and the Cooleys. No one ever thought that either family would be able to produce the sixth generation before the chain was broken; but the young Miss Spaulding married a young Mr. Gulley, and with only a few weeks to spare brought forth the baby which has made the family renowned."

Mr. Brookens adds that "these people live from 14 to 20 miles from my studio. They had planned to have a big gathering at the home of No. 2" (*i. e.*, the first of the upper row in the photograph) on her 79th birthday, September 4, 1908, and I had been engaged to make the photograph that day, but No. 2 died August 30 and was buried September 1. On September 4, as prearranged, the five living parties were photographed and I copied from an old photo the deceased lady. So you see that all six generations were living from July 25 to August 30. The oldest lady is ninety-five past, she has 41 grandchildren and 167 descendants.

"Margaret Elder died about twenty days after baby Gulley was born."

The five mothers married at ages 18, 15, 17, 15, 15, thus averaging 16 at the time of marriage.

Minute details regarding the Pass family, the second family to have six generations living at one time, are lacking, but the following facts can be vouched for as coming direct to Dr. Gould from immediate members of the family.

Anna Maria Pluck of Pennsylvania was born October 15, 1808, and died October 23, 1908. She married Isaac Pass, great nephew of Jacob Pass, in whose foundry (Pass and Stowe) was recast the Independence Bell.

EXTREME LONGEVITY

Her daughter, Margaret Elizabeth Pass, was born March 7, 1837, married Thomas David. Her daughter, Lillie David, was born August 8, 1853, and married Mr. Sayres; a daughter, Lucy Sayres, was born February 2, 1872, married Mr. McDade. Emma McDade, daughter, was born November 8, 1888, and married Mr. Feinman; their child Celestes Feinman, was born on July 1, 1907. The photograph, here reproduced, was taken either on the 27 or 29 of September, 1908.

The longevity of a century in each case. together with early child bearing and unusual fecundity, make these cases almost without parallel. It is to be hoped that other investigators will be able to discover similar families and to furnish additional data.

The Effect of Recessive Factors[1]

If we have two plants with a pair of contrasted characters inherited in alternative fashion, we are obliged to consider these as consequences of the presence of alternative factors, A and a, in the germ-cells. Then we usually can only compare the effects of the factorial pairs AA, Aa, and aa. We usually know nothing as to the effect of A alone or a alone, or of aa in the presence of A, etc. The work of Hayes and East on triploid inheritance, makes it probable that in the endosperm of maize, in a certain pair of factors, Aaa produces the same effect as aa, and AAa the same effect as AA. Here both factors of the pair have a definite influence. Some influence of the recessive factor is probably indicated also in Morgan's crosses of certain sex-linked factors in Drosophila, where the heterozygous female Aa differs from the male $A-$, in the particular character. In cases classed as multiple allelomorphs we consider both factors of a pair as producing definite effects. According to the presence and absence hypothesis, the recessive factor (or one factor of the pair, where the heterozygote is clearly intermediate) is always zero. This hypothesis seems to have experimental support, only where the effect of Aa is apparently the same as that of AA. A study of the inheritance in tetraploid primulas with special reference to any influence of the recessive might be fruitful.

[1]Hays, H. K. and East, E. M. Further Experiments on inheritance in maize. Conn. Agr. Expt. Sta. Bull. 188, 1915.

A NEW FORAGE PLANT

Russian Sunflower of Great Promise for Irrigated Mountain Valleys of Northwest —Crop Stands Ten Feet Tall and Keeps Down Weeds —Is Valuable for Silage.

F. B. LINFIELD

Director of Montana Agricultural Experiment Station, Bozeman, Mont.

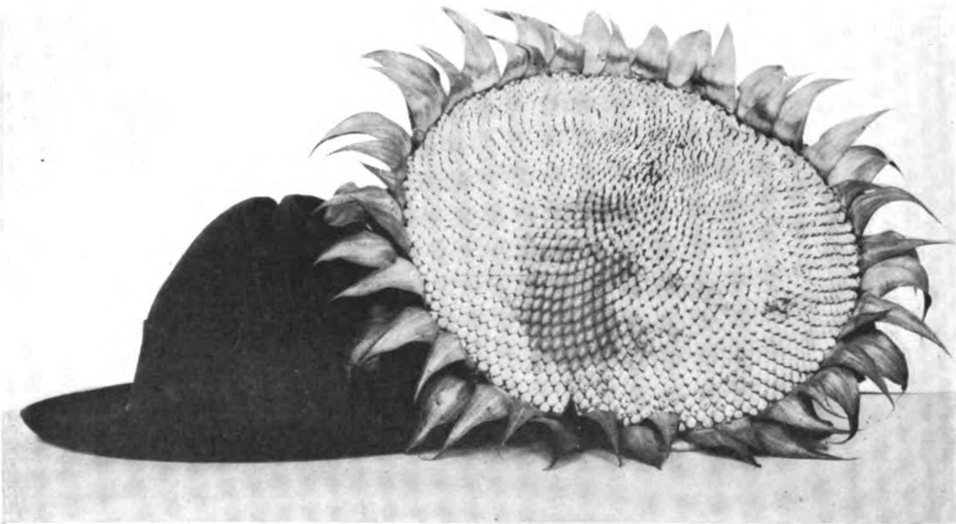
IN ALL new agriculatural countries the farmer's first problem is to subdue the native sod and replace nature's crop by something of greater economic value. The soil is generally rich, and quite free from weeds. By the adoption of crops best suited to the climatic conditions, provided an ample water supply may be provided, good crops are possible for many years. Sooner or later, however, the farmer runs up against two difficulties if he continues to grow grain exclusively upon his land. A reduction in available plant food reduces his crop yields to the point of vanishing profits and weeds also cut into those profits by increasing the amount of labor necessary to get a crop, or they may even crowd the crop out altogether.

SOIL ENRICHMENT NECESSARY

In any system of farming, therefore, the farmer is finally compelled to grow soil enriching crops or to apply home produced or artificial fertilizers. Such

HARVESTING SUNFLOWER SILAGE

Growing from nine to twelve feet tall, as much as thirty tons of green feed per acre. When put in the silo, it kept well and was readily eaten by cows and fattening steers during the winter. (Fig. 13.)



SUNFLOWER BLOOM OF HUGE SIZE FROM MONTANA

During the last three years experiments have been carried on at Bozeman, Mont;, which have shown that the sunflower fulfilled remarkably well the need for a forage crop which would yield a high tonnage and help control the weeds. (Fig. 14).

crops will also help to control the weeds but experience has taught us that we cannot master them completely without a bare fallow or summer-tilled crop. In many parts of the United States, corn, beans, potatoes or sugar beets furnish the cultivated crops that may be grown on a large enough scale to fit into a rotation system. We are, however, too far from market to grow potatoes in large areas, beans and corn are not adapted to our high altitudes. They are too uncertain and too small in yield to be grown to advantage.

Another problem was to find a forage crop that would yield a high tonnage under our conditions. In the lower valleys alfalfa is the large yielding forage crop and it does very well in most of the high valleys, as also does clover, but these alone would not control the weeds.

Some four years ago one of our extension men visited a farmer in the Flathead Valley in the Northwestern part of the State who was growing Russian Sunflowers, which were very large producers of forage. He suggested to our agronomist that he believed this plant had possibilities as a forage plant under Montana conditions. Acting on this suggestion in the summer of 1915 a small area, about 1/10 acre, was planted to sunflowers in our experimental field. The crop was planted in rows some 3 feet apart and grew immensely, producing over 30 tons of green feed per acre. The crop was cut and put into the silo, which was being filled with clover. It was put in when the silo was about half full so that there was clover both above and below the sunflowers. During the winter it was fed to our dairy cows which ate the sunflower silage as readily as they did the clover silage and seemed to do just as well upon it.

The next season (1916) we planted 3 acres of the sunflowers, planting in rows about 30 inches apart. The crop was

LOADING GREEN FEED INTO SILOS

Sunflowers make an equally satisfactory forage for cattle whether fed as a soilage crop or as ensilage. It has the drawback of having to be run through an ensilage cutter before it can be used to advantage, but makes a very good winter feed when cut. (Fig. 15).

not irrigated, though some sub-irrigation water was available from seepage. The crop grew well, stood 9 to 10 feet tall and yielded about 22 tons of green feed per acre. We started to feed the sunflowers to the cows the latter part of August. They were run through an ensilage cutter and fed green from the field. The cows ate the forage readily. For comparison we divided the cows into two lots and fed green corn to one of the lots. The cows on the sunflowers ate this forage just as readily as those getting corn and maintained their milk flow just as well. This test was continued for some three weeks. The sunflowers remaining were put into the silo and fed during the winter to both cows and fattening steers. Samples were taken of the green forage for chemical analysis but the destruction of our chemical laboratory last fall destroyed these and prevented the chemical studies contemplated. The results of the feeding test were very satisfactory, however.

Some fear was expressed that the sunflowers would taint the milk, so the milk from the cows getting the sunflowers was kept separate from that produced by the cows getting the regular feeds. One could not find any difference in flavor as a result of the feeding of the sunflowers. In other words, one guessed wrong as often as he guessed right in picking out the milk of the cows fed the sunflowers.

The past season we planted 7 acres to the sunflowers. Again the crop did well, growing 11 or 12 feet high and yielding close to 25 tons of green forage per acre. We repeated the feeding comparison with the green corn as a food and with equally as good results as the year before. We have this year filled a 125-ton silo nearly full of sunflowers and have planned this winter to repeat the test of last year. We have also taken samples for chemical analysis.

Two facts, I believe, we have demonstrated: first, that the Russian sunflowers make a satisfactory forage for cattle, whether fed as a soiling crop or as

ensilage. Next, it is our largest yielding forage crop, producing fully two and one-half times as much forage as will corn in our high valleys, and more than twice as much as clover for the season. It is, moreover, a crop that can be cultivated and later so thoroughly shades the ground that weeds get a very poor chance to grow. It has one drawback in that it must be run through an ensilage cutter before it can be used to advantage as forage for cattle, and can only be cured in the silo for winter use.

We have yet many points to study as to the best method of growing the crop and with what other forage it is going to combine to give the best results. We are also trying out the crop on the dry lands in various parts of the state, to determine its value, under those conditions. We are not as yet urging farmers to grow the crop largely but merely asking them to try a small area to find out how it yields, and those who have ensilage cutters can also try it as a forage for cattle. It is worthy of a trial by other experiment stations which are located as we are in a high mountain valley.

Factors Affecting Egg Production

After a long experimental study of the factors affecting egg production, E. D. Ball and Byron Adler[1] have made the following interesting conclusions. Environmental factors influence the records of pullets more than those of mature hens. The curve of distribution in a low record flock is practically parallel with that of a high record flock. This was also true of individual hens.

The production of general purpose breeds was compared with that of Leghorns. General purpose breeds reached their maximum early in the season and rapidly fell to moderate production, while Leghorns reached their maximum a month later, but continued to produce heavily for several months.

Winter egg production is more variable than annual production and seems to be closely correlated with environmental factors. Flocks that made low records the first winter made high ones the second and *vice versa.* Those with low first winter records made higher three-year records than high first-year flocks. The correlation between first winter production and that of later years was only 25%.

The higher the production of an individual, the great percentage will be made in winter, regardless of age. There does not seem to be any foundation for the assumption of a division of the laying period into units. The date of hatching, when kept between March and May, did not appear to influence total production. The time between hatching and laying affected total production, the latest maturing pullets being the poorest producers. The date of laying the first egg was not important except as indicating the length of time to maturity.

New Paper-making Materials

The Imperial Institute of India has recently reported in *Commerce Reports* the success of its experiments with three new paper-making plants that may be of use in developing new fibers. *Ecdeiocolea monostachya*, a rushlike plant belonging to the order Restiaceae found only in Australia, furnishes stems from two to five feet in length which yield 44% pulp, and a slightly darker paper than that of Algerian esparto grass. An African tree, *Neoboutonia macrocalyx*, which attains a height of fifty to sixty feet, was also tested, and a pulp was produced from its timber which bleached easily, giving an opaque and almost white paper which did not shrink on drying. Brachystegia bark (Brachystegia Randii) was also prepared, the pulp when unbleached, giving a strong, dark brown paper, or when bleached, a white paper of good quality. Because of unfavorable local conditions in Rhodesia, the home of the tree, however, it is improbable that this last could be of commercial promise at present.

[1] E. D. Ball and Byron D. Adler; *Factors Affecting Egg Production*, II.

COLOR INHERITANCE IN MAMMALS

X., The Cat—Curious Association of Deafness with Blue-eyed White Color and of Femaleness with Tortoise-shelled Color, Long Known—Variations of Tiger Pattern Present Interesting Features.

SEWALL WRIGHT

Bureau of Animal Industry, Washington, D. C.

Tabby cat with tiger-pattern vSIAEXb

$1a_1$	—	
$1a_2$	V,v	V—white (normal or blue eyes)
	S,s	s—piebald (unit factor uncertain)
$1a_3$	I,i	i—dilute tabby (maltese and cream)
1b	—	imperfect albinism of Siamese cat?
$2a_1$	A,a	a—black
$2a_2$	E,e	Ee—tortoiseshell female ee or e- —orange (male or female)
$2a_3$	—	
2b	—	
3	Xa, Xb, Xc,	Xa—finely lined or uniform tabby Xc—wide striped or blotched tabby

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373 August, 1917.

TWO remarkable peculiarities, associated with color in cats, have been known for a long time. Darwin[1] mentions the fact that blue-eyed white cats are generally deaf, and also that tortoiseshells are nearly always female.

Investigations on the blue-eyed white cats have been made by Przibram[2] and by Whiting.[3] The latter has not yet published his results, but has very kindly permitted some mention of them here. Wholly white cats may have the yellow eyes of ordinary colored cats, or they may have blue eyes, or one eye may be yellow and one blue. Whiting finds that solid white, whatever the color of the eyes, is due to a unit dominant factor. Przibram crossed together white cats with various eye-colors. The data are not extensive enough to base final conclusions on them, but there seems to be inheritance of the eye color. There was some indication that asymmetry ran in families, but not a specific kind of asymmetry. The variations in eye-color can best be looked upon as analagous to the variations in extent and symmetry of the white pattern in the coat of any piebald mammal. Asymmetry in such patterns has never been demonstrated to have a heredity basis. A tendency for asymmetrical eyes to run in families in cats could be explained as due to heredity of a general level in amount of color, independent of the main factor for solid white. Some families are at such a high level that the white pattern seldom invades the eyes, which therefore remain yellow. Others are at so low a level that all individuals are blue-eyed. In families at an intermediate level, it is largely chance whether or not an eye is invaded by the white, and asymmetry is common. When the pattern is sufficiently extensive to invade the eyes, it is easy to understand that it might also invade the inner ear, but why this should cause deafness is not so clear. The allied case of deafness in wall-eyed white dogs has been noted in the previous paper. The preceding discussion interprets the solid white condition as an extreme form of a piebald pattern, and not at all comparable with albinism.

White patterns, resembling the usual piebald patterns of other mammals, are very common in cats. No doubt the factor or factors, which are responsible, are independent of the other color-factors, as spots of all colors can appear on a white ground. The mode of inheritance does not seem to have been worked out.

DILUTE COLORS IN CATS

The dilute color of the maltese cat, as compared with the black variety, has been demonstrated to be due to a simple recessive factor by Doncaster.[4]

The same factor reduces orange to cream, and the ordinary black-and-orange tortoiseshell to a maltese-and-cream tortoiseshell. The effects are very similar to those produced by the dilution factors of mice and rabbits and the factor thus fits in well with class $1a_3$.

A very different kind of dilution is present in the Siamese cats. These are born white but become a sort of fawn color with dark chocolate on the ears and feet. The eyes are deficient in pigment and appear blue. Bateson[5] noted the similarity to the Himalayan rabbit. The mode of inheritance is not known, but the appearance strongly suggests that the variation is homologous with imperfect albinism as found in rats, rabbits, guinea-pigs, and dogs and belongs in class 1b. If this is true, blue-eyed Siamese and the ordinary blue-eyed white variety are variations of very different kinds. The first is near the extreme in a dilution or albino series; the second, the extreme in a piebald series.

TORTOISESHELL AND ORANGE

The first attempt to explain the curious correlation between tortoiseshell color and female sex in cats was made by Doncaster,[6] who suggested that there is a difference in dominance, in the sexes, in the opposed pair of characters, orange and black. Thus he supposed that orange is completely dominant over black in males, but imperfectly dominant in females, which, therefore show a patchwork of orange and black. Little[7] made crosses which led him to advance the hypothesis that the orange factor is linked with the sex-determining factor in heredity, a mode of inheritance which had been discovered, in the mean time, by Doncaster in the moth Abraxas. He assumed that females are homozygous for the sex-determining factor, males heterozygous. Thus females may be of any of the three types, EE, Ee, or ee, black, tortoiseshell, and orange respectively, while males can only be of the types, E- or e-, black and orange. This hypothesis was also adopted by Doncaster[8] in his next paper as explaining the main facts, but he noted the existence of rather frequent discrepancies between expectation and observation. The following table gives the results which he obtained from breeders. Tabby and maltese are included with black, the various kinds of tortoiseshells are combined, and some cases called doubtful are omitted. The discrepancies are in italics.

	Females			*Males*		
	Black	*Tort.*	*Orange*	*Black*	*Tort.*	*Orange*
Black ♀ × Orange ♂	*13*	51	..	51	*1*	..
Tortoise ♀ × Black ♂	14	22	..	32	*1*	37
Tortoise ♀ × Orange ♂	*6*	45	53	45	*1*	58
Orange ♀ × Black ♂	..	16	..	..	.	20
Orange ♀ × Orange ♂	..	*3*	40	..	.	48

22 discrepancies among 263 females.
3 discrepancies among 294 males.

Doncaster advanced several hypotheses to explain the discrepancies, *e. g.*, imperfect sex-linkage, difficulty in distinguishing dilute tortoise from maltese, and, later, non-disjunction. Whiting[9] found it possible to produce all grades of tortoise from nearly self orange to nearly self black, and suggested that occasional overstepping of the limits between the colors, due to coöperation of independent minor factors for extension or restriction of black, would account for the aberrant kittens. Ibsen[10] advanced an hypotheses involving a high degree of linkage between a factor for tortoise as opposed to yellow and a factor for black as opposed to yellow, but was obliged to fall back on Whiting's explanation in some of the cases.

DATA FOR FEMALES LESS RELIABLE

The writer is inclined to accept Whiting's explanation in the main. There is, however, a difficulty with all attempts at explaining the discrepancies which should be pointed out. In Doncaster's data there are many

more discrepancies among females than among males. He finds 22 exceptions among 263 female kittens, or 8.4%, but only 3 among 294 males, or 1.0%. A color which depends on a sex-linked factor is inherited by males wholly from their mothers. Thus black females (EE) should have only black sons (E-), yellow females (ee) only yellow sons (e-), and tortoiseshell females (Ee) both blacks (E-) and yellows (e-) in equal numbers, regardless of the colors of the sires. The data fit the theory admirably among the 294 males except for the occurance of 3 tortoiseshells. Cutler and Doncaster[11] have recently presented evidence indicating that tortoiseshell males are generally sterile. This makes it probable that something more is involved than the action of subsidiary extension factors, and the authors suggest that there may be a connection between the sterility and the possession of a color normally belonging to the female. Putting this suggestion in a definite form, it may be taken to mean that the rare tortoiseshell males may be cats with the two X chromosomes of females, but in which some other cause has overbalanced the sex-determining tendency of the X chromosomes, and produced males or near males. Such an interpretation would fit well with the results of Whitman and Riddle[12] in sex control in pigeons, and with Goldschmidts[13] work on sex-intergrades in Gypsy moths.

The absence of other discrepancies among the males shows that very few if any of their mothers could have differed in color from that expected on their genetic constitution. But these same mothers produced 8.4% aberrant daughters which in the next generation would be expected to produce many aberrant sons. More experiments under laboratory conditions are needed. Almost any records should give reliable results for males since there should never be any question about the identity of the mother of a kitten, but for females, the sire must be known as certainly as the dam and certainty as to the sire is notoriously difficult to establish in cats.

The effects of the factor, which change black to tortoise or orange, place it on the whole in class $2a_2$, with the factors for tortoise and self yellow in guinea-pigs. As has been noted before, however, the distinction between classes $2a_2$ and $2a_3$, *i.e.*, factors which determine a patchwork of black and yellow and those which determine a uniform change in the density of black, is not very sharp. In a few tortoise-shell kittens, which the writer has observed, the black parts of the coat have a brownish hue and appear much less intense than the black of solid black kittens of the same litters. This indicates that, in cats of formula of Ee, there is a general reduction in density of black which easily passes into complete elimination in irregular spots in the coat. This leads to comparison with the sooty yellow or tortoiseshell rabbits which have even more claim to be put in class $2a_3$.

THE PATTERN OF TABBY CATS

The common tabby cat has a very complex pattern with an obvious relationship to the color patterns of wild Felidae, and these are of a general type which is very common among other wild mammals. Several kinds of variations are found in domestic cats and a study of these is of great interest for the light it throws on the colors of mammals in nature. In the common tabbies with the tiger pattern, there are alternate dark and light stripes running perpendicularly down the sides of the body, longitudinally along the back and head, and around the legs and tail. The dark stripes are usually of hair which is wholly black while each hair in the light stripes is black with a cream colored band near the tip, thus resembling the hair of agouti-colored rodents. The colors on the back are more intense than those on the belly. The variations in the tabby pattern have been studied in much detail by Dr. Whiting to whom the writer is indebted for permission to use genetic results on which the following discussion is based.

The two elements in the tabby pattern, *i.e.*, the striping of the coat as a whole, and the banding of individual hairs, vary wholly independently of

each other. With the same pattern of stripes, the banding may vary from very wide, giving the cat a nearly yellow appearance, to very narrow. Indeed in solid black cats, in which the banding is wholly eliminated, the pattern of stripes can often be made out, especially in kittens, in a so-called ghost pattern. Darwin[14] mentions this point. According to Pocock,[15] the ghost pattern is due to a difference in glossiness in stripes representing those of tabbies.

In cats, with given widths of banding the character of the stripes may vary very greatly. There are three distinct types according to Whiting. In the so-called blotched tabby the stripes are very wide, few in number, and much broken up. The common tiger pattern has been described above. There is also an almost uniform tabby in which the stripes have become so narrow that they lose their distinctness for the most part. Ghost patterns of all of these types may be seen in different black kittens.

CLASSIFICATION OF VARIATIONS

The possibility of combining any grade of banding with any kind of striping indicates that independent kinds of factors are involved. Before considering the mode of inheritance, we may attempt to classify the factors involved. For this purpose a comparison of an ordinary black-and-yellow tortoise shell with a tabby-and-yellow tortoiseshell is very instructive. The black and the tabby spots differ just as do solid black and solid tabby coats. The yellow areas in the two coats, on the other hand, will be found indistinguishable. This, however, is not because the pattern is lost. The yellow of the black-and-yellow tortoiseshell, as well as of the tabby-and-yellow kind, shows distinct alternate stripes of orange and cream. In the tabby tortoise, the dark stripes of the tabby areas continue as orange stripes in the yellow part of the coat while the light, banded stripes of the tabby continue as cream in the yellow part.

The fact that there is no visible difference between the black and the tabby tortoiseshells in the yellow parts of the fur shows that the banding factor, by which alone these varieties differ, does not act on color in general, but merely on black. We may describe its action by saying that it has no effect on enzyme I, but inhibits enzyme II during part of the development of the hair. Doncaster[16] showed that tabby is dominant over black and differs by only one factor. Thus banding in cats appears to be in every way comparable with the banding of agouti-colored rodents and the dominant factor may be put at once in class $2a_1$. The variations in the width of the bands may be due either to multiple allelomorphs of this factor as in cases discussed in the papers on mice, rabbits, and guinea-pigs, or they may be due to subsidiary factors, which vary the density of the black, which the banding factor must inhibit; and similar to those noted in guinea-pigs.

The case is very different with the stripes. The contrast in intensity of the orange and cream stripes shows that these differ in the activity of the fundamental color-producing enzyme, enzyme I. As there is little or no effect on the intensity of black, the difference in intensity is more like that due to factors of class 1b than of class $1a_3$. Greater activity of enzyme I, in the intense stripes, does not, however, account satisfactorily for the reduction or elimination of the bands in the latter, in tabby cats. To take a parallel case, reduction of the black-and-red agouti variety of guinea-pig to the sepia-and-cream agouti variety by a factor of class 1b, has no appreciable effect on the width of the red or cream band. It is necessary to suppose that the dark stripes have a greater activity of enzyme II, as well as of enzyme I, and that this tends to neutralize the inhibiting action of the banding factor. It will be seen that this interpretation is identical with that reached in the case of the agouti patterns of rodents, if the whole back of the mouse, rat, rabbit, or guinea-pig is compared to a dark stripe of the cat, while the belly of the rodent is compared to a light stripe. It should be added, however, that there is also a difference between the back and belly of cats, probably comparable to the

situation in rodents, but of lesser importance than the difference between the stripes.

FACTORS OF REGIONAL DIFFERENTIATION

In cats, there is a feature which finds no parallel in the rodents mentioned above. In the latter cases, the difference between back and belly in the activities of enzymes I and II, was supposed to hold for all individuals and to be merely revealed more or less clearly in the different color varieties. In cats, we have actual variations in the localization of the patterns. According to Whiting, the three types of tabby, finely lined, striped, and blotched, segregate sharply in crosses and are probably inherited as a series of three allelomorphs in which the highest dominant is the lined pattern, while the blotched pattern is the lowest recessive. Although the stripes differ in the activity of both enzymes I and II we cannot compare this series of factors with the combined factors of classes 1b and $2a_3$. They do not determine an ascending or descending sequence in activity of enzymes I and II, but instead a sequence of types of regional differentiation. Both the dark and light stripes are wide in the blotched tabby, relatively narrow in the tiger tabby, and reduced to mere lines in the lined tabby. The fact that variations of both classes 1 and 2 are involved suggests that the dark strips come to differ from the light ones at some critical period in development by a general metabolic difference which effects the activities of both enzymes, rather than by a specific chemical difference. This was the view adopted to account for the difference between back and belly in the rodents and the differences between males and females in tricolor guinea-pigs. On this view, the Mendelian factors for the different types of striping determine short, medium, or long waves during the development of the epidermis in some general metabolic condition at the critical period in development for determination of color.

No other unit Mendelion factors have been noted in mammals which determine a type of regional differentiation but the existence of hereditary factors of this kind was noted in piebald guinea pigs and in cattle. In the latter especially, the different types of pattern which have become fixed in the white-faced Herefords, the white-belted Dutch cattle and the irregular Holsteins, with a given quantitative grade of piebald, is especially noteworthy. Such factors, which determine a type of regional differentiation, must be put in a new class.

TABLE OF FACTOR COMBINATIONS

	EE(♀) or E–(♂)	Ee(♀)	ee(♀) or e–(♂)	Pattern
vSIAXa	Tabby.......	Tabby-yellow tortoise	Yellow.......	lined or uniform.
AXb	Tabby.......	Tabby-yellow tortoise	Yellow.......	Striped = tiger pattern
AXc	Tabby.......	Tabby-yellow tortoise	Yellow.......	Blotched.
				(Black vs. cream agouti in tabby areas; orange vs. cream in yellow areas.)
aXa	Black........	Black-yellow tortoise	Yellow.......	Lined or uniform.
aXb	Black........	Black-yellow tortoise	Yellow.......	Striped-tiger pattern.
aXc	Black........	Black-yellow tortoise	Yellow.......	Blotched.
				(Ghost pattern, if any, in black areas; orange vs. cream in yellow areas.)

V—converts any color into solid white with or without reduction of eyes to blue.
s—adds piebald white pattern to any color variety.
i—reduces all black in above patterns to maltese, all orange to cream and cream nearly or quite to white.

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French Stocks in Canada

In the November issue of the JOURNAL OF HEREDITY, I find a lengthy quotation from the work recently published by the Scribner's, at New York: *Mankind—Racial Values and Racial Prospects*, by Seth K. Humphrey, "a Boston business man and author, but a serious student of biology."

Speaking of Canada, Mr. Humphrey has written the following:

"The cloud on her racial horizon is her legacy of original French stocks, which persist in remaining at a genetic and cultural level below that of the dominant English-speaking population. They may fill a worthy place in Canada's economic scheme, but they do not furnish their proportion to the essential ability of Canada's people, and to that extent are a hindrance to her racial future."

Mr. Humphrey seems to ignore that:

As regards the "genetic level," the French Canadians—who, up to the latest period, have doubled their numbers every twenty-five or thirty years (a phenomenon almost unique in history)—are the descendants of perhaps the best choice of colonists that ever peopled a colony. As may easily be ascertained from history, it was not left to any one indiscriminately to come to New France. The authorities, on the contrary, were careful to favor the introduction of none but persons most commendable by their moral and their religious spirit, and who, as a fact, originated from the best provinces of France. It is no less remarkable that, either owing to the fact that there always existed in the colony a considerable proportion of highly cultivated ecclesiastics, functionaries and military officers, or because a great many of the settlers came from the region of Paris, the pure French idiom, and not any of the *patois* then spoken, and spoken even at the present day, in different parts of France, was established and maintained in New France, now the Province of Quebec.

As for the "cultural level," the French Canadians possess two great French Universities, and twenty classical colleges, where the Greek, Latin, English and French language and literature are thoroughly taught. In the average attendance of pupils in schools of every nature and grade, the French Province of Quebec, during the period 1901–1915, has surpassed, in a notable degree, that of all the other provinces of Canada. In the intellectual field, there is hardly any section, literary, scientific or artistic, in which, alongside the greatest name of the English race in Canada, the French Canadians are not able to place one of their own who can equal and sometimes surpass his competitor.

Many times have statesmen and writers in England congratulated Canada for the "French stocks" she owns, and the important services accruing therefrom, far from being "a hindrance to her racial future."

CANON V. A. HUARD, D. Sc.,
Editor of "Le Naturaliste Canadien."

The American Genetic Association

NATIONAL CAPITAL PRESS, INC., WASHINGTON, D. C.

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

APRIL, 1918

ORGAN OF THE
AMERICAN·GENETIC·ASSOCIATION
WASHINGTON · D.C.
Printed for Circulation among Members only

Plans for the Journal During the War, the Council's Appeal to All Members of the Association

IT is with the keenest regret that the Council of the American Genetic Association finds it necessary to change the policy regarding the Journal of Heredity. The cost of publication has increased about 30 per cent, and our funds are no longer sufficient to maintain the Journal on the present basis of regular monthly issues.

The collapse of so many of the foreign journals devoted to this field of science makes it appear all the more necessary that the activities of our Association be maintained. Most of our members must see very clearly the immense importance of establishing more widely the scientific, eugenic point of view, in relation to the fundamental questions of human welfare, that are pressing upon us as never before.

The war is showing us how defective our civilization is, demonstrating the enormous need of scientific investigation and popularization in dealing with the more fundamental problems of national and racial welfare. It is felt that instead of being compelled to enter upon a policy of retrenchment at this time the Association should consider it a patriotic duty to maintain its activities through this period of crisis.

It may be that the financial difficulty could be met by raising the dues of the members to $3.00, but this might tend to restrict the membership, either now or in the future. An active effort to increase the membership would be very much better. Undoubtedly the membership of the Association could be doubled if each member would ask himself which of his friends or acquaintances would and should be interested in the Journal, and then bring the matter personally to their attention. Finally, there may be more members who are able and willing to subscribe to the guarantee fund which a few have maintained for several years past. Some of our guarantors have not been active members of the Association, but have considered its objects as worthy of support, and it may be that some of our members can secure the interest of other broad-minded, public-spirited citizens who feel as much responsibility for furthering constructive undertakings as for palliative charity.

The Council appeals, therefore, to the membership of the Association for an expression of opinion as to the course that should be followed under the circumstances, in relation to the raising of the dues or to any other steps that should be taken, and especially it appeals for such active support as can be given by increasing the membership or contributing to such an increase of the guarantee fund as would insure a continuance of the Journal.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. IX, No. 4 April, 1918

CONTENTS

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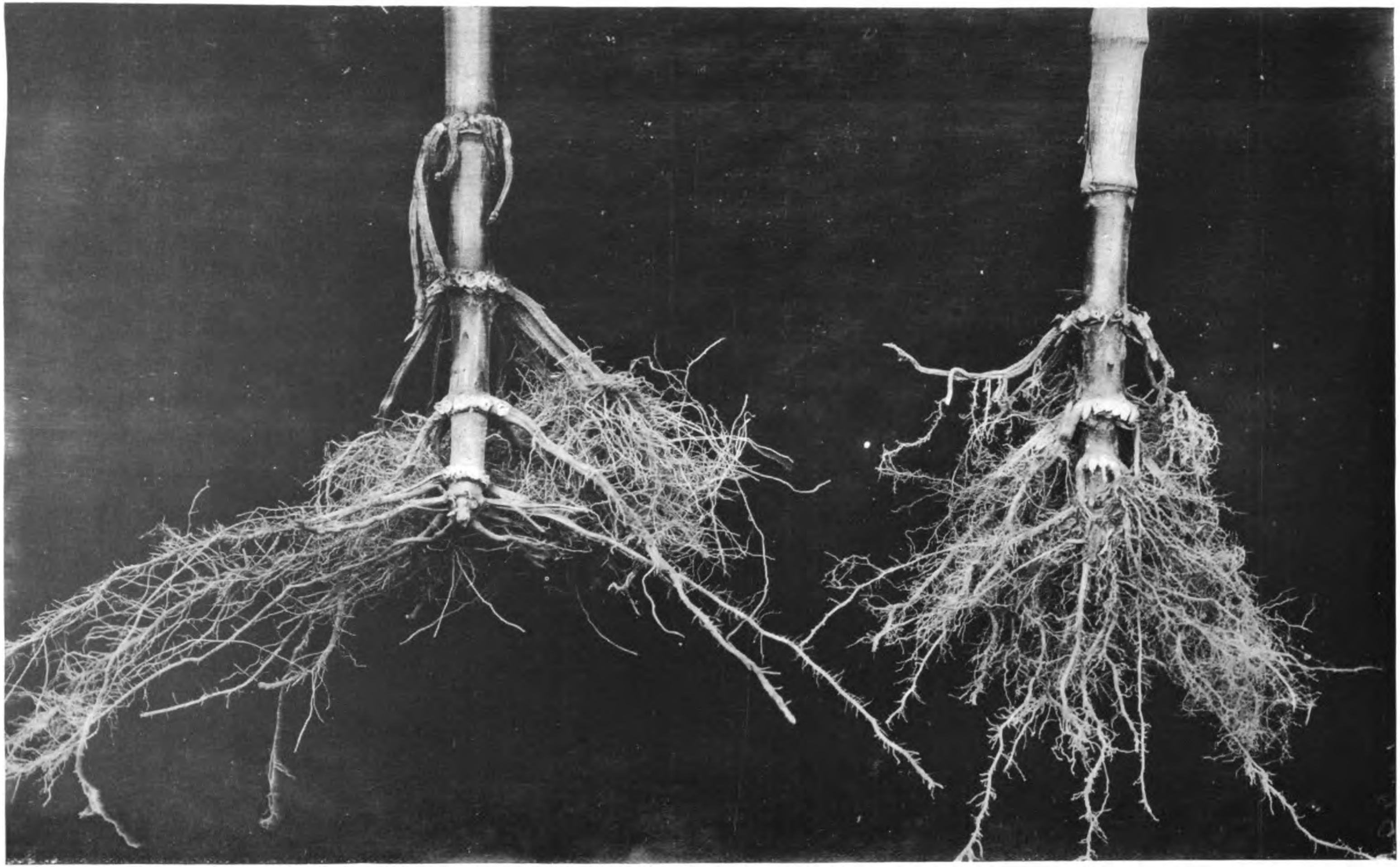


COMPARATIVE ROOT DISTRIBUTION OF MAIZE

Root distribution of *Zea hirta* to the left, and of an ordinary dent variety on the right. The surface distribution of the roots of *Zea hirta* enables this type of maize to utilize the water from light showers and even dew. On the other hand, the failure of its roots to penetrate the soil precludes utilization of stored moisture. (Frontispiece.)

TROPICAL VARIETIES OF MAIZE

Great Diversity of Types of Maize—Most Important Food Crop Cultivated by Natives of America at Time of Discovery—Plant Shows Wide Distribution[1]

G. N. COLLINS

Bureau of Plant Industry, U. S. Department of Agriculture

MAIZE, or Indian Corn, was the most widely distributed and by far the most important food plant cultivated by the natives of America at the time of the discovery. It is still the most important American crop plant, and while much more productive strains have been developed than any grown by the aborigines, the range of the species on the American Continent has not been greatly extended.

To be able to grow under the widely different conditions that are found in the region from central New England to Argentina and Chile, there must be a great diversity of types. How great this diversity is and how inadequately it has been utilized in developing strains adapted to the needs of the different agricultural communities it is the object of the present paper to discuss.

The Department of Agriculture here at Washington has for a number of years been collecting the types of maize from the different parts of the world. These varieties have been grown and their characteristics studied with a view to determining which of the characters they possess may be utilized in developing varieties better adapted to the different parts of the country.

It has not been possible to make an adequate survey of the existing varieties of any country and there are many regions of which we have practically no knowledge of the kinds of maize. Agricultural expeditions that are sent out are usually compelled to pass more or less hurriedly through the countries they visit and the explorers in charge are always charged with collecting a great variety of plants and data, so that little more can be done than to snatch what is exhibited in the markets or what is found growing immediately along their routes. Such collections have been supplemented by seed secured from consuls and correspondents. While many valuable introductions have been secured in this way, ignorance of the normal behavior of the varieties and of the cultural and climatic conditions under which they have been grown often stand in the way of making the most of the peculiar qualities they may possess.

As a result of this rather haphazard manner of securing material our collections are very uneven. In some few places the series of varieties is comparatively complete, but there are whole countries not represented in our collection by a single maize variety. Enough has come to light, however, to show that, especially in the countries of tropical America, we have an immense storehouse of valuable material that awaits the utilization of the breeder.

We have come to believe that the search must be made for characteristics rather than for varieties ready made, as it were. It seldom happens that a variety from one locality will be found adapted to any other locality, but often the most unpromising and insignificant variety, grown perhaps by some backward tribe of natives, will possess some peculiarity or adaptation that needs only to be combined with the desirable qualities of other varieties to become of great value.

Instead, therefore, of attempting to present any complete description of

[1] Paper presented before the Second Pan-American Scientific Congress, Washington, D. C., December 27, 1915–January 8, 1916.

varieties of corn, I shall enumerate a few of the more striking adaptations that have thus far been discovered, beginning with the varieties grown by the Indians of the western United States.

HOPI MAIZE

The Hopi, Navajo, and Zuñi Indians are still growing a type of maize that seems to have spread but little outside the region inhabited by these tribes. The prevailing type of seed is soft or amylaceous, the plants tiller abundantly, they are early maturing, and make comparatively rapid growth at low temperatures. Their exact water requirement has not been determined, but it would appear that they are comparatively economical in the use of water. These characters, while valuable, are all quantitative. This type of maize does, however, possess one unique feature. All other types of maize thus far studied produce three or more roots from the seed. These roots support the young plant until the permanent roots that develop from the nodes have been formed. In the type under discussion there is but one root developed from the seed. The economy of this arrangement seems to be that the single root is able to penetrate to a greater depth than is possible when the reserve material of the seed is divided among three or more roots.

In combination with this character there is also the possibility of a much greater development of the mesocotyl than in other types. The mesocotyl is a specialized organ found in the seedlings of maize and some other grasses. It may be described as the part of the main axis that connects the seed with the first leaf of the seedling. So long as the germinating seed remains in the dark, the mesocotyl elongates, stopping only when the tip of the seedling reaches the surface of the ground or the limit of elongation is reached. In planting their maize the Hopi Indians dig into the sandy soil until they reach moist earth, usually found at a depth of from 6 to 18 inches. The seed is deposited in these holes in contact with the moist soil. Although these holes may be left only partly filled, the drifting sand soon fills them, and to reach the surface the young plants must penetrate from 6 inches to a foot of soil.

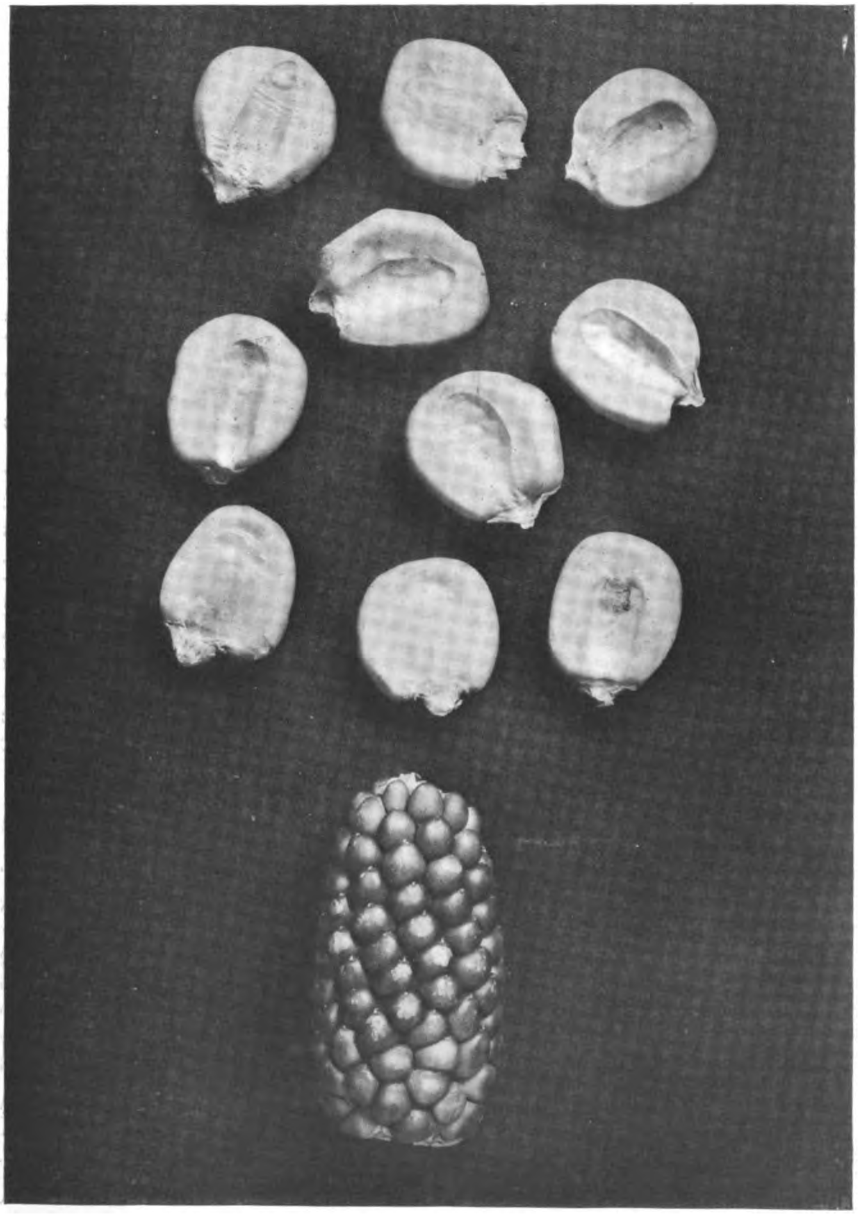
Experiments have shown that commercial varieties of maize planted under these conditions will not reach the surface. The maximum development of the mesocotyl in commercial varieties is from 8 to 10 centimeters. After this elongation is reached the leaves attempt to expand beneath the ground, and as they unfold they are not sufficiently rigid to force their way through the soil.

It was found that the mesocotyl of Hopi maize is capable of elongating to a length of 36 centimeters or over three times the length attainable in other varieties. At the same time the single strong seminal root is following the retreating moisture and keeping the young plants alive until the summer rains wet the soil above and allow the development of lateral roots. A long mesocotyl thus divides the work of reaching moisture with the single seminal root and the combination makes possible the establishing of young plants in soils where the nearest available moisture is a foot or more below the surface of the ground.

These peculiarities make this type of maize beautifully adapted to the conditions that obtain on the wind-swept plateaus of northern New Mexico and Arizona where the variety is grown. In this region there is a winter rainfall, but by the time the weather is sufficiently warm to warrant the planting of maize, the surface soil is thoroughly dry. Summer rains may be expected in June or July, but if planting were delayed until the rains came there would not be time enough for the crop to mature before the frosts came in September.

These adaptations should find an application wherever maize is planted during a dry season, and the young plants are forced to depend on moisture stored in soil. At San Diego, Cal., the past season plants of this type matured normally without a drop of rain during the growing season.

That adaptations of so great economic importance should exist inside our own country and remain unnoticed is a striking indication of how inadequately the possibilities of maize development have been investigated.



MAIZE FROM PERU AND BOLIVIA

Seeds of Cuzco maize from Peru and an ear of a Bolivian variety of maize having the quality of remaining green a long time after maturity. Photograph natural size. (Fig. 1.)

Another set of interesting adaptations have been found in a type of maize from the table-lands of Mexico. This type was early recognized as a distinct form. In 1829 it was given specific rank by Bonafous under the name *Zea hirta*.

The most striking characteristic of this type is a peculiar development of hairs on the leaf sheaths and also to some extent on the blades. For this most conspicuous peculiarity we have not as yet been able to discover any adaptive significance.

On the tablelands of Mexico where this maize is grown the rainfall is very light. In the parts of the United States with a similar rainfall maize productiont is not considered possible. We were, therefore, extremely optimistic regarding the utilization of this type of maize. Our early experiments were very disappointing. In the semiarid regions of the West this variety was a complete failure. Instead of being drought resistant the plants appeared to suffer from drought more than the ordinary varieties from the corn belt. Without the viewpoint that each distinct type of maize possesses adaptive characters this variety would have been discarded as worthless. As soon, however, as the variety was scrutinized with respect to the separate characteristics instead of trying to utilize it as it was, important adaptations came to light. The first peculiarity noticed was the nature of the root distribution. In this type of maize the roots seem to have lost the ability to penetrate the soil. In a full grown plant the roots are all horizontal and confined to the upper 6 inches of soil. There is so little direct attachment to the soil that the whole plant can be lifted up and down by the hand. The plants are on rather than in the ground. This peculiar root distribution helps to explain why the plants are able to grow in Mexico with so little rainfall and why they fail in the western part of our country. In the part of Mexico from which this variety was secured the little rain that falls comes during the growing season in the form of light, misty showers. The rainfall is at no time sufficient to penetrate to any extent and an extensive superficial root system is best adapted to utilize the moisture.

This particular adaptation we are unable to utilize in this country, for in the drier parts of the United States the rainfall comes largely in the winter instead of during the growing season, and growing plants must draw their water from that stored in the ground some distance below the surface. There are, however, many regions in tropical America where this adaptation should be of value. Through the work of Briggs and Shantz, of the Department of Agriculture, it has been shown also that *Zea hirta* is the most economical of water of any of the varieties of maize yet studied.

Still another adaptation possessed by this type of maize was observed during the past season in the course of experiments conducted near San Diego, Cal. It there developed that this type of maize made satisfactory growth at lower temperatures than any of the other types with which we were experimenting. This does not mean frost resistance, nor does it mean that this type is suited to extend maize growing farther north. It means rather that this type possesses one of the characteristics necessary to a variety of maize for regions where the temperatures are uniformly too low for the ordinary varieties. Temperatures below the optimum for maize are the rule over a large part of the elevated regions of the tropics. In the development of varieties for cool climates, this type of maize promises to be of great value. Our experience with *Zea hirta* shows also the folly of looking for drought resistance as such. To make progress, we must distinguish between the different kinds of drought resistance and search for the particular adaptation needed.

Nearly every region from which we have received varieties has contributed adaptations that promise to be of value. From Bolivia has come a type possessing to a marked degree the quality of remaining green for a long time after maturity. Mexico has given us one variety with the largest ears and another with the ability to withstand extremely

WAXY CHINESE MAIZE

A typical plant of the Waxy Chinese variety of maize, showing numerous tassel branches, erect leaf blades and curved tassel. The kernels of this remarkable Chinese maize have a waxy endosperm which distinguishes them in a striking way from other varieties of maize. Photograph by courtesy of the *Journal of Agricultural Research.* (Fig. 2.)

high temperatures. Peru contributes the largest seeds. From China comes a variety with a new type of endosperm and the ability to withstand hot dry winds at the time of flowering. Our best protected ears come from Guatemala.

Enough has now been said to indicate what is meant by adaptation and how the varieties must be studied to realize and appreciate the adaptations. Only a beginning has been made. When it is realized that no two regions present exactly the same environment and that maize, though a very ancient crop, is very plastic and has molded itself to the conditions under which it has been grown, some idea may be gained of the multitude of adaptations that await discovery.

RECOMBINATION OF CHARACTERS

A word must now be said regarding the recombination of these adaptations into new varieties suited to new conditions or representing an improvement over varieties already existing.

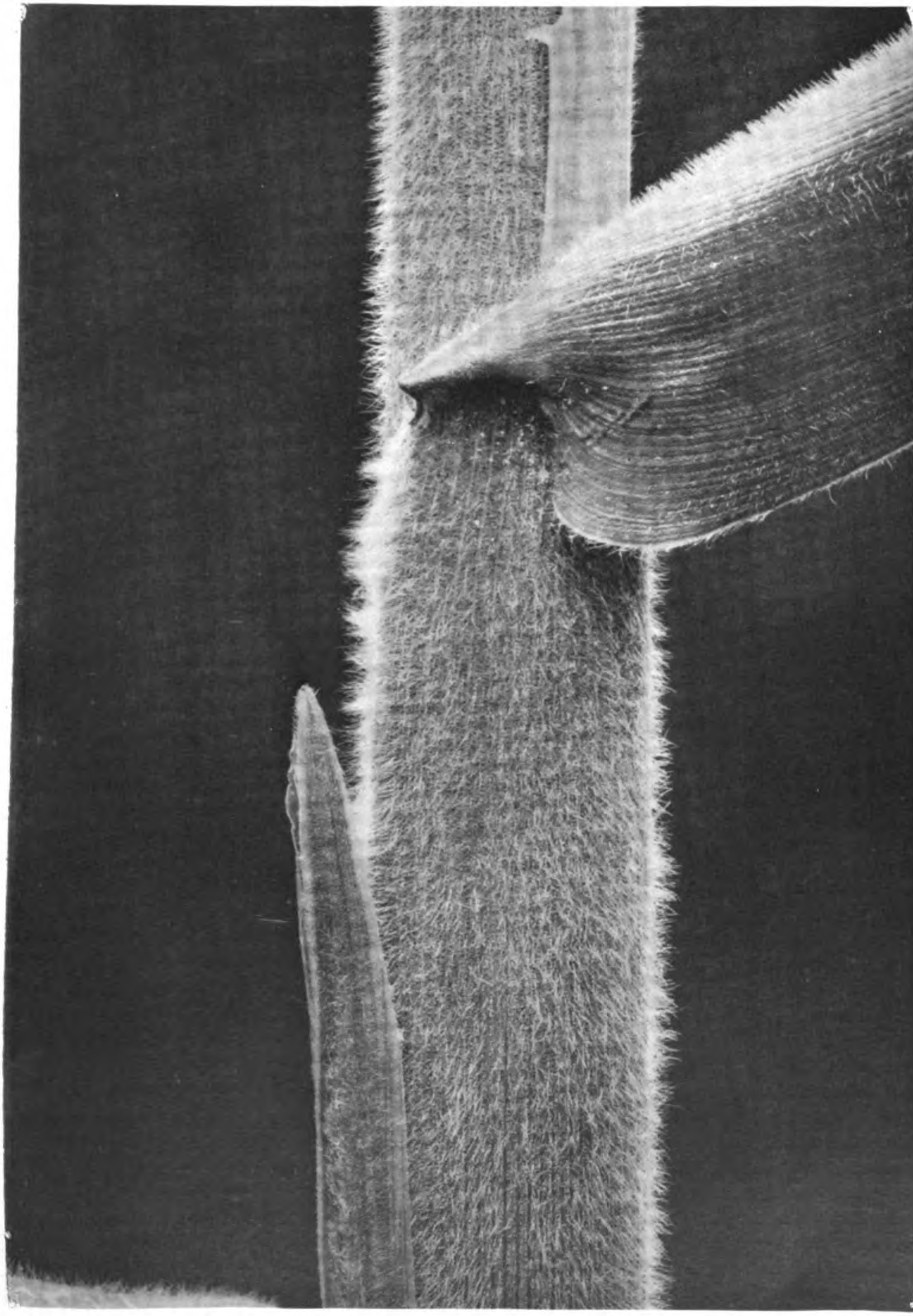
Regarding the recombination of characters, our knowledge is still very imperfect, but here also a beginning has been made and results sufficient to serve as demonstrations have been secured. An example may be taken that is particularly applicable to tropical America.

When a traveler from the north visits tropical America and finds maize a staple crop and often growing luxuriantly, he is naturally struck by the absence of table or sweet varieties so generally grown in this country. I have made inquiry in a number of instances and almost invariably have been told that sweet varieties have been introduced, but that they did not do well, and that their growth was given up on that account. If it were possible to combine the palatability of the sweet varieties with the luxuriant growth and freedom from insect attack of the native varieties, a valuable addition might be made to the rather meager list of really delicious vegetables available in many parts of the tropics. We are to some extent confronted with the same problem in our own southern states where the ravages of the corn worm practically preclude the growing of commercial varieties of sweet corn.

In the breeding of commercial varieties of sweet corn, one of the most important considerations has been earliness. In breeding for earliness the number of leaves has been reduced. In reducing the number of leaves the number of husks, which are homologous to leaves, have also been reduced with the result that the ears of sweet corn are poorly protected. This was of little or no importance north of the region infested by the corn worm, but it is this that renders the commercial sweet varieties unsuited to southern regions.

In 1912 crosses were made between commercial sweet varieties and southern varieties of field corn having well protected ears. The first generation plants were grown in 1913, and selections were made from those plants with the most perfectly protected ears. From the ears thus obtained, which contained a mixture of sweet and non-sweet seed, we selected the sweet seed for planting in 1914. In that season the plants were very variable, but all the seeds were sweet. Crosses were made between the most promising plants, special attention being again paid to the covering of the ears. The results of the past season demonstrated that we already have a fairly uniform and productive variety of sweet corn. Although grown in a region where the infestation of corn worms is particularly severe the damage to the ears was insignificant, less, in fact, than was the damage done to field varieties in the same region. Thus in three years we have combined the sweet seeds of the table varieties with well-protected ears of the larger field varieties. It would appear that there is no valid reason why any region that can grow maize successfully should be without sweet varieties. Whether earliness must necessarily be sacrificed, or whether it is possible to secure earliness and still keep the well-protected ears, is an interesting question that must await further investigation.

All characteristics cannot be manipulated as easily as the sweet endosperm, which from the alternative nature of its inheritance permits of



A HAIRY VARIETY OF MAIZE.

Leaf sheaths of the Esperanza variety of maize, showing the maximum development of tuberculate hairs. Photograph by courtesy of the *Journal of Agricultural Research*. (Fig. 3.)

Mendelian recombination, but our experiments indicate that most of the characters of maize are independent of one another in inheritance and that recombination is only a question of careful selection following hybridization.

CONCLUSIONS

The work of discovering new and valuable characteristics is one in which a coöperative arrangement among the different maize-growing countries of America would be especially applicable. Once an adaptation is observed and the discovery announced, it becomes available to all countries.

Of course, an important step to take is the interchange of varieties, but it is of equal importance to have the varieties studied in their native countries by observers familiar with the maize plant and its variations.

I would strongly urge that each of the maize-growing countries of America make a canvass of the maize varieties existing within its boundaries. In the study of these varieties the particular conditions under which they have developed should be kept in mind. Thus, if a variety is found growing in a region of cool nights, high winds, or any other pronounced environmental factor an effort should be made to determine how the variety meets the peculiar condition. I venture again to call attention to the necessity of looking for desirable adaptations rather than desirable varieties and to urge that no variety be overlooked simply because it appears insignificant or worthless. If a variety is growing under climatic conditions that are extreme in any particular, it is more than probable that the variety possesses valuable characteristics.

Improper Feeding among New York School Children.

Thirty-three per cent of the girls and 38% of the boys in two New York public schools are suffering from improper feeding, due to ignorance of what constitutes a suitable diet under present conditions, according to studies made by New York social workers, utilizing the medical services of the Department of Health and the Association for Improving the Condition of the Poor.

The school lunch is considered a direct way of meeting the problem revealed by these studies Nutritional clinics have been established and a special committee of the pediatric section of the New York Academy of Medicine has been appointed to coöperate in the experiments now proposed. The first of these experiments is an extension of the existing school lunch service at School No. 40, East 20th Street, where twenty-five of the children are to be given one meal a day for three months. The Post Graduate Hospital, the New York School Lunch Committee, and the People's Institute are cooperating to bring the utmost of scientific control to the experiment and in making known the results in terms of physical improvement, scholarship, cost, and applicability of the results to school children generally.

The menus for the feeding experiment have been carefully worked out by Dr. Mary Schwartz Rose of Columbia University and Miss Lucy K. Gillette, dietitian of the Association for Improving the Condition of the Poor. These menus are to contain 900 calories. The foods selected are those most easily available to the people during the present war time crisis and those which should be used for purposes of conservation. The boys volunteered to eat these meals for a period of three months as "Food Scouts" to prove what food in war time children must eat in order to reach proper physical development.

ADVERTISING NEW PLANT FOODS

War Conditions Make Evident Necessity of Forming Food Habits of People Along Right Lines—This Work Should be Especially Directed by Department of Agriculture—Incessant Hammering of Modern Advertising Has Created a Vast Market For Many Commercial Products.

DAVID FAIRCHILD

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

THE days of the helter-skelter of democracy are drawing rapidly to a close. "The method of leaving the development of society to the confused welter of forces which prevail within it" must give way. We have "discovered the necessity and value of a conscious direction of its activities." The war is making this great change evident to everyone. We must know what we are doing as a people, and our habits—our likes and dislikes—must form the study of our most brilliant minds. The results of these studies must be taken to all the people with the same certainty as the advertisements of the great corporations are hammered home, until they become brain patterns on the mind of every man, woman and child, patterns as clear as, or clearer, than Coca Cola, Cascara, or Quaker Oats.

FOOD HABITS OF VAST IMPORTANCE

Our food habits—why should they not form one of the very first and most important problems with which this conscious direction should concern itself? "Food will win the war" is now on every stamped envelope. If this is true, then the food habits of the people form one of the most vital problems at the present time, and are likely to do so for some years to come.

To the generation just past, paternalism was considered a great error, something that would undermine the morals of the people. My first experience in the introduction of plants into America was with this mistaken bugaboo of democracy.

I was asked, by the head of the Division of Horticulture of the Federal Department of Agriculture, to secure for a pioneer, who was trying to establish the citron industry on his place in the foothills near Los Angeles, some cuttings of the citron of Corsica. After the negotiations had proceeded so far that I was on my way to Corsica the matter came to the attention of the Secretary. "I would just as soon give a man a set of Plymouth Rock eggs as to get for him, at government expense. a lot of cuttings of the citron," was his reply. (And as a result I got the cuttings with my own money, and it was a long time before the Government ever paid me back.) This is a bit of department history that has never before been published.

Today the Office of Foreign Seed and Plant Introduction is expending a hundred thousand dollars a year in getting and handing over to just such pioneers as Smith, of Monrovia, Calif., new plant material from foreign countries.

PRODUCTS SHOULD BE MADE KNOWN

It is now twenty years since this work was begun, and we have arrived at still another step in the progress towards paternalism which it is evident to me is necessary. This step is the conscious direction of the people in acquiring new food habits.

We have been aiding the new industries to get the material with which to begin; and the pioneers have been putting their lives and their money into the growing of the trees and the plants, and the acquiring of the necessary information with regard to their cultivation and the handling of the product, and

now they are ready to put their pet products on the market. But, alas, there is no market. They have convinced themselves that the fruit or the vegetable is better in some respects than what their neighbors are growing, and that there are good reasons why it should be grown over a considerable area of land, but they have spent all the money they could spare in the growing of their product and they have never considered the selling end. They have done what the farmer has done so often, neglected the selling end of the proposition.

ADVERTISING TOO COSTLY

Now it is entirely beyond the limits of the pocketbooks of any man or small body of men to put up the money for the advertisement of a new vegetable. Advertising is expensive, and the prices paid by the big manufacturing firms would be out of the question for the producer of a new vegetable. He simply could not do it. Before one got back in sales the money which he put into advertising he would find that some one else was growing the same or a similar product and reaping the benefits.

Is this state of affairs to be always left to the helter-skelter competition of food manufacturers with secret processes, and the manufacturers of foods which are so well known that only superior quality counts anyway?

If it is important for the people that these new plants should be developed into plant industries, then it seems to me that a market for them must be created and the necessary advertising be done by the Government.

MARKET HARD TO SECURE

This doctrine is the result of experience, not merely an office view of the situation. I have had the experience of seeing farmers become interested in a new industry, of seeing them plant several acres to a new crop, and then, when the harvest time came, discover that nobody was going to help them advertise the fruit or the vegetable; and, not being men of large means, their enthusiasm has melted away and the industry, which deserved a larger try-out and a fuller experience, has died out for lack of advertising. Had 1% of the money spent every month in the advertising of some new brand of chewing gum been available for the new and wholesome food, sales could have been made, the growers encouraged to go ahead, and a new plant industry established. In the one case a new chewing gum, made from the same ingredients as any other, has supplanted some other chewing gum with absolutely no good results as far as the public is concerned; in the other the death of an industry which would have brought new land areas under cultivation and made safer for the future our agriculture and more secure our food supplies of the future.

DISEASES MUST BE COMBATTED

For it must not be supposed by the public that there is any certainty that we shall be able always to combat the epidemic diseases of plants. Nor must it be forgotten that these may gain in virulence with the extension of the areas planted. Nature is not made in any one mold, and each case will have to be fought out singly. We have spent hundreds of thousands of dollars trying to grow the old world grape in the Eastern States of America and have utterly failed. The history of the pioneers in the establishment of the American grape industry is illuminating in this connection. This industry deserved to have a much smoother path and to have sacrificed many less pioneers.

Under our very eyes today the same kind of a struggle is going on in the South where the delicious Scuppernong grape is being developed, and the growers are trying, without organization, and with only half-hearted government aid, in the form of advice and experimental work, to create a market for what is in reality a delicious new drink. At the same time a single concern with a mixture of California grape juices has worked up a trade in a new drink and is selling it by the carload. This new drink has been built up by concentrating capital on the simple mat-

ter of salesmanship. In the one case the growers of the Scuppernong grape cannot sell their product because they have no salesman and cannot afford to engage one. In the other, an already established industry creates a market for a new drink by skilful advertisement.

The question which I want to ask is: Why should not the Government have expert salesmen?

LARGE FIELD FOR CORN AND RICE

Had the success of the corn campaign in Europe been followed up as it should have been years ago there is little doubt but that the ignorance which has prevented the Belgians and English from eating corn cakes and other corn products would have been immensely minimized. Had salesmen been employed to teach the people how to cook rice and encouraged its consumption we would have, instead of the paltry consumption of seven pounds per capita, something approaching the amount which we ought to consume. An active rice campaign might have prevented the overbalanced sugar consumption of 90 pounds which we now have, largely as the result of the advertising placards and newspaper urgings, and the incessant hammering of thousands of salesmen along the line of natural small resistance. These chocolate and candy and ice cream and sweet drink manufacturers have had free access to the public, and have developed in the children of the coming generation a sweet tooth which will require the sugar plantations of the West Indies and the East Indies as well to supply. And this, too, in the face of the fact that the sugar habit, like the alcohol habit, has objectionable features about it which the doctors have long ago pointed out.

The conscious direction of the food consumption of the people will, I conceive, bring into existence the government salesman, and with it the development of what has already come in other lines government advertising and government street car posters and fence advertisements.

DISCRIMINATION AGAINST PRODUCTS

The newspapers and magazines have always looked upon the stories about new foods in the light of news, and they have always been glad to spread any items of interest which would help the sale of things in which the farmer is interested. They have drawn the line when it comes to the advertising of any manufactured product—that was advertising and should pay its way.

The path of the government salesman should be made easy since he would not be working for any one small set of men, but for the development of a new plant industry which would be free for all to enter, and would support, on the land, families which would add to the building up of the country. When the industry reached a stage where it could afford to organize and engage its own salesmen then would be the time for the Government to withdraw its support.

Ohio Germination Tests Reveal Lack of Good Seed Corn.

Most of the corn harvested in Ohio in 1917 is not fit for seed, according to the Ohio Experimental Station, which has been testing nearly two thousand samples representing almost every county in the State. Crib and field lots range in germination from 1 to 40%.

Corn gathered and stored under artificial drying conditions before the freezing weather last December show 90 to 100% germination in these tests. Half of the corn kept from the crop of 1916 tests this high, and three-fourths of such samples are above 80%.

Seed corn this spring must come from three sources: A few farmers stored their corn early so that it was well dried out when cold weather came. Some corn matured comparatively early in southern counties and can be used in that part of the State. All old corn from 1916 should be held for seed and tested for germination.

Since local seed corn is always safest, from three sources: A few farmers to buy as near home as possible and to test each ear before planting.

ANOTHER CHANCE FOR THE FILBERT

Previous Attempts to Grow Filberts Along Atlantic Coast Failures—Layered Plants Now Growing Successfully in Maryland Suggest a Retrial of this Valuable Nut Tree in Eastern United States—Filbert Nuts Might Form a Valuable Addition to War Foods

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AFTER repeated failures in trying to grow the European filbert successfully in the eastern United States, comes the report that layers brought into Maryland from introduced trees grown by the late Felix Gillet are exhibiting great vigor and unusual freedom from disease and are so promising as to suggest a retrial of these valuable nuts on the Atlantic Coast. In case they succeed in becoming well established and resistant to eastern diseases and pests, a vast field will be opened where eastern growers may compete with the exportations from the Old World. Although commercial growing in the northwest has been made an actuality during the last quarter of a century, immense opportunities for the development of the industry still remain.

The best varieties of the northwest, including the Barcelona and DuChilly, were developed by the late Felix Gillet. and for this reason, the Maryland trees may well be taken to be the most vigorous and resistant which can be produced. So far they have made a splendid showing. But it is very possible that it is because of an isolated position and because of the fact that they have not yet been exposed to attacks by the filbert blight that they have been immune. It will be necessary to have them more widely distributed and more exposed to infection before any definite claims for immunity can be set forth. The filbert blight has so far succeeded in destroying all European filberts which have been planted along the Atlantic coast, and may not yet have reached the new Maryland layered plants.

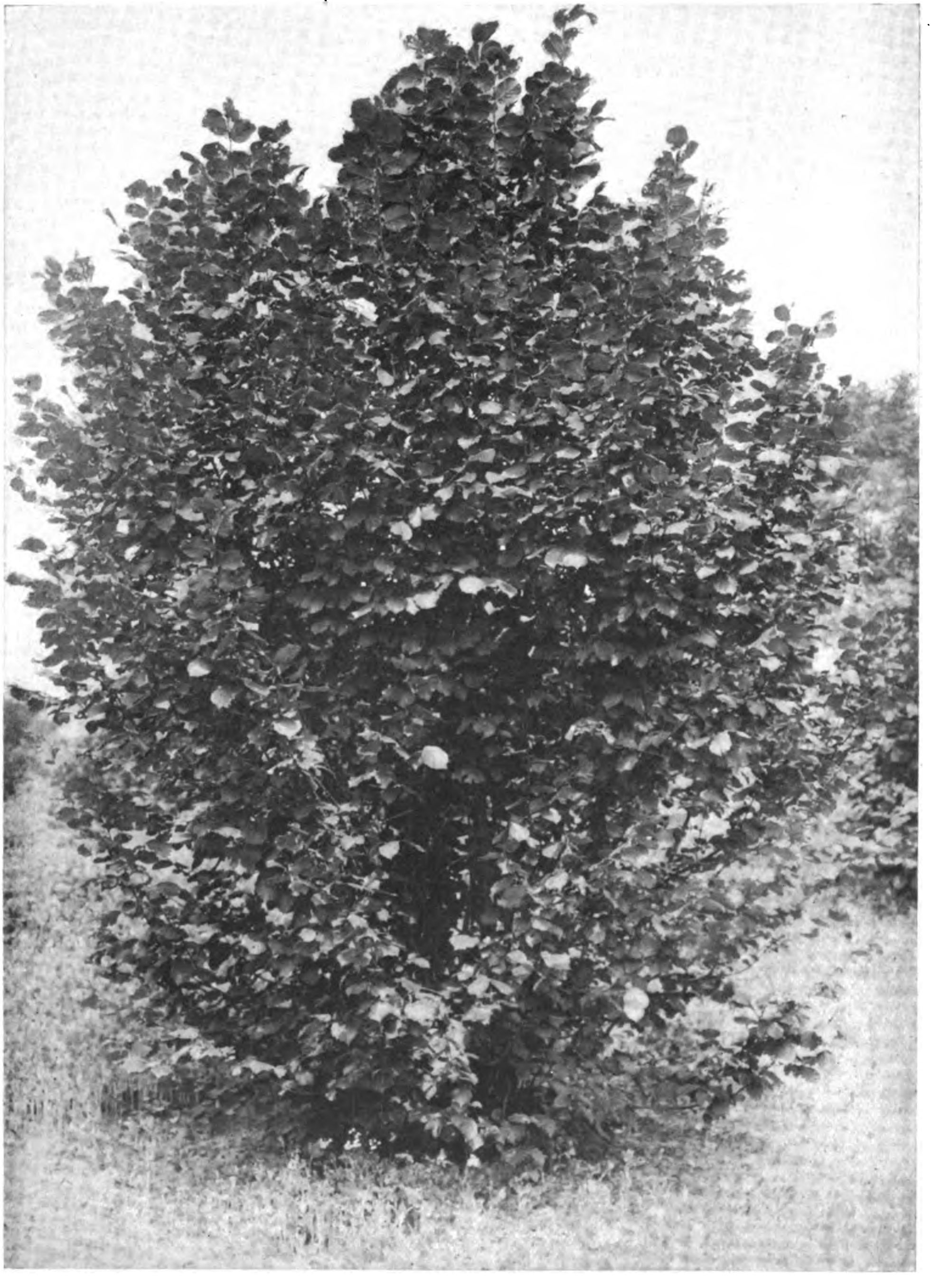
Although filberts have entered largely into the diet of the inhabitants of the Old World since an early epoch, being highly praised by Virgil himself, these delicious nuts of unusual food value have been almost in the nature of a curiosity in America, especially along the North Atlantic Coast, and except for an occasional importation sold in small quantities at such prohibitive prices as to make any use of the nut as a food product an impossibility, have been practically unknown to the general public.

Due to the fact that filbert exportations from the Old World amounted to millions of dollars annually, many attempts have been made to introduce the growing of filberts into this country, but it is only during the last quarter of a century that sufficient success has been attained to warrant plantations for commercial purposes. Even during this time, practically all the successes were scored in the western and northwestern parts of the United States, it seeming to be impossible to secure varieties that would do well along the Atlantic Coast.

There are two native species of filbert (*Corylus rostrata and C. americana*) which would appear to be of value in the American field, but due to their relatively small nuts are unable to successfully compete with the two European species (*C. Avellana* and *C. Colurna*). *C. Avellana* of which the Barcelona, Du-Chilly and Géant des Halles are all varieties, seems to be on the whole the best adapted to American needs.

NUT OF GREAT ANTIQUITY

The history of the filbert as a food product is lost in the mists of antiquity. It may have been known to the Romans as *Nux Pontica*, probably introduced from Pontus. The Italian name of *Avellana* seems to have been first applied to the wild hazel of Britain long before



8-YEAR-OLD FILBERT IN MARYLAND

Felix Gillet, of Nevada City, Cal., a French nurseryman and writer on the subject of filberts and almonds collected at his Barren Hill Nursery a number of the best European varieties of filberts. The illustration is of a tree of the *Géant des Halles* variety of *Corylus avellana* raised in Maryland from a layer of one of this collection. The great vigor and unusual freedom from disease of the whole collection and the fact that they bear regularly suggest the advisability of trying them again in the Eastern States on well-drained hillsides. (Fig. 4.)

THE BARCELONA VARIETY OF EUROPEAN FILBERT

Although our American hazelnuts (*Corylus americana* and *C. rostrata*) are familiar to most, the larger-fruited cultivated filbert of Europe (*Corylus avellana*), is still comparatively unknown in the Eastern states, except in the markets, and has only begun to attract attention in California, Oregon, and Washington. The behavior of several varieties brought into Maryland as layers from introduced trees grown by the late Felix Gillet of Nevada City, Cal., is so promising as to suggest a retrial of various varieties of this valuable nut on the Atlantic Coast. (Fig. 5.)

it was adopted by Linnaeus as the specific name of the indigenous species. Virgil states in Eclogue vii that it was more honored "than the vine, the myrtle or even the bay itself."

Members of the genus Corylus long enjoyed the distinction of being endowed with occult powers, and twigs from them were used as divining rods for locating treasures, veins of metal, subterranean water and even criminals, and this miraculous power is still believed in by many people at the present day. Although the powers were later attributed to other plants as well, most notably to the peach and the witch hazel the myth has always been connected principally with the Old World nut tree.

Improvement of Beans in Manchuria

The *Manchuria Daily News* states that the South Manchuria Railway's agricultural station has been experimenting on the improvement of Manchurian beans for several years. Species from Ssupingkai have been distributed to different places.

The results in 1917 were favorable on the whole, and about 20% increase in the yield was realized. Moreover, the new output is superior in weight, percentage of oil, luster, etc. These seeds are to be more widely distributed in 1918.

LETHAL FACTORS AND STERILITY

Certain Factors Cause Death of Homozygous Embryos—Sublethal Factors or Combinations Also Affect the Zygote—Action on Pollen Grains and Embryosacs

JOHN BELLING, *Washington, D. C.*

I. LETHAL FACTORS, OR COMBINATIONS OF FACTORS, ACTING ON THE ZYGOTE

A NOMINALLY recessive (actually intermediate) genetic factor, causing the death of all embryos homozygous for it, was demonstrated by Baur, in Antirrhinum, in 1907 (2). On selfing, the heterozygote, Aa, gave $1A_2^1 : 2Aa : Oa_2$ (1 green: 2 gold-color). Similar factors have been found in several other cases. In these plants, the embryos burst the seed-coats, and sometimes, as in maize, have a sufficient food store to grow leaves some inches long. But in *Oenothera lamarckiana*, as Renner (37) has shown, ½ of the embryos die in the seeds, without emerging. It is, I think, likely that such a mortality in the seed exists in other cases; probably in Vibmorin's dwarf wheat (52) which was constantly heterozygous, and gave approximately a ratio of $OA_2 : 2Aa : 1a_2$ (two dwarf to one tall) when selfed; and possibly also in many first-generation species hybrids.

In the heterozygote Aa, where a_2 is lethal, if any factor B is linked with A, then a plant heterozygous for AB will give progeny, as regards B, in the proportion of $(m^2+2mn)B_2 : 2(m^2+mn+n^2)Bb+(n^2+2mn)b_2$, where $m:n$ is the gametic ratio for coupling or repulsion. The resulting numerical ratios for coupling (Table I) show a deficit in recessives increasing as the coupling becomes closer, and a small excess in homozygous dominants, the ratio of dominants to recessives increasing from over 3: 1 to an indefinite extent as the gametic ratio increases. For repulsion, on the other hand, there is a correspondingly large decrease in homozygous dominants and a small increase in recessives, the ratio of dominants to recessives varying with the gametic ratio from under 3: 1 to a limit of 2: 1. Hence, wherever there are lethal factor combinations, as in species crosses, we may expect to meet with ratios of dominants to recessives in the second generation differing from the usual 3: 1 ratio, because of linkage and crossing-over. I have shown (7) that crossing-over occurs in some species crosses.

TABLE I

Ratios in progeny of $AaBb$ plant, where a_2 is lethal, and A and B are linked.

Gametic ratios AB or ab: Ab or aB	$B_2 : Bb : b_2$	Dom.: Rec.
2: 1	8: 14 : 5	4.4: 1
5: 1	35: 62 : 11	8.8: 1
10: 1	120: 222 : 21	16.3: 1
100: 1	10200: 20202: 201	151.3: 1
1: 2	5: 14 : 8	2.4: 1
1: 5	11: 62 : 35	2.1: 1
1: 10	21: 222 : 120	2.0: 1
1: 100	201: 20202: 10200	2.0: 1

In the case of *Oenothera lamarckiana*, the death of half the embryos, as well as the results of crossing, are met by Renner's hypothesis; that, after selfing, a pair of factors, or combinations of factors, are lethal to the zygote, when homozygous; so that L_2 and l_2 are eliminated, and only Ll embryos left. Then a factor B, linked with L, will be found in the proportions of $mnB_2 : (m^2+n^2)Bb : mnb_2$, the numerical results being given in Table II.

TABLE II

Ratios in the progeny of an $LlBb$ plant, when L_2 and l_2 are lethal combinations, and L and B are linked.

Gametic ratio	$B_2 : Bb : b_2$	Dom.: Rec.
2: 1 or 1: 2	2: 5 : 2	3.5: 1
5: 1 or 1: 5	5: 26 : 5	6.2: 1
10: 1 or 1: 10	10: 101 : 10	11.1: 1
100: 1 or 1: 100	100: 10001: 100	101.0: 1

There is here a large excess of heterozygotes, increasing rapidly with the intensity of the linkage, the results for coupling being the same as those for repulsion.

II. SUBLETHAL FACTORS, OR FACTOR COMBINATIONS, AFFECTING THE ZYGOTE

These factors usually cause the death of a fraction only of the zygotes possessing them, the mortality varying with the environment from zero to perhaps *total*. *Selective elimination*, or *differential viability*, are terms often applied to this mortality, which may be found in the second generation of plant crosses, especially wide crosses. When vicinism is absent, the presence of sublethal factors may often be recognized by the abnormal ratios in the second generation, which usually include a lessened proportion of recessives. A back-cross of F_1 with a full recessive best shows this differential viability. In Matthiola, Saunders (40) found the heterozygote 1 to 1 double-thrower to have a sublethal factor combination. In flax, Tammes (46) ascertained that in a cross of blue and white-flowered races, in a progeny of 4,000 plants, there was always a deficit in the recessive white-flowered. The white-flowered plants were found to have 13% fewer seeds in a seed vessel than the blue-flowered plants of the same family: and of the seeds the white-flowered plants produced, a smaller percentage germinated than of those from the blue-flowered. Hence a_2 was sublethal to the embryos. (Aa plants, however, were apparently just as viable as A_2 plants.) After reckoning in the observed mortality, the ratios agreed with expectation.

If a recessive sublethal factor a_2 is the cause of selective elimination in the case of x of the individuals possessing a_2 in the second generation; then a factor B being linked with A, there will be found, among the n surviving plants of the second generation, $3x$ plants which will be with regard to B in the proportions $(m^2+2mn)B_2: 2(m^2+mn+n^2)Bb: (n^2+2mn)b_2$; while the $n+3x$ remaining plants of the second generation, in which a_2 was not present or was not eliminated, will be in the ordinary proportion of $1B_2: 2Bb: 1b_2$. It was shown above that the former of of these two proportions gives ratios greater than 3:1 for coupling, and less for repulsion. Hence, in all cases where a factor B is linked with a sublethal factor, A or a, the second-generation ratios will differ from the normal, not only for A and a, but also for all other differential factors in the same chromosome pair.

III. LETHAL FACTORS, OR FACTOR COMBINATIONS, ACTING ON THE POLLEN GRAINS AND EMBRYOSACS (HAPLOID GENERATION).

These factors cause partial sterility, where only a definite fraction of the pollen grains and embryosacs remain viable. They cause a selective elimination of pollen grains and embryosacs, and their effect must be distinguished from that of zygotic factors which also may cause a total abortion of pollen grains (as in the recessive sweetpea with aborted pollen, 18), or of embryosacs (as in some double petunias), or partial abortion (as I have found in some F_3 families from Stizolobium crosses); but do not cause selective elimination among members of the haploid generation.

A special case of partial sterility due to lethal combinations of factors is *semi-sterility*, where half of the pollen grains and half of the embryosacs perish because of their possession of such lethal combinations. Semi-sterility has been especially studied in three Stizolobium crosses (5 and 6), where a satisfactory hypothesis was that each of the two combinations of factors, KL and kl, not found in the original parents, was lethal; while either of the two combinations, Kl and kL, peculiar to the parents, was not lethal. H and P were factors (for lateness of flowering, and pigmentation of seedcoat) linked with K. In F_2, both H and P occurred in the usual 3:1 ratio, notwithstanding the elimination of pollen grains and embryosacs. But the second generation consisted of fertile and semi-sterile plants in equal numbers. Among these two classes, the factor H,

for example, was to be expected in the following different proportions.

	H_2 : Hh : h_2
Fertile plants....	(m^2+n^2) : $4mn$: (m^2+n^2)
Semi-sterile plants.	$2mn$: $2(m^2+n^2)$: $2mn$

With a gametic ration of 5:1, which approximates the figures actually found, the plants would be in the following proportions (7).

Gametic ratio, 5:1 or 1:5	H_2: Hh: h_2	Dom.: Rec.
Fertile plants.......	26 : 20 : 26	1.8 : 1
Semi-sterile plants ..	10 : 52 : 10	6.2 : 1

The fertile plants have a large excess of homozygotes, and the semi-sterile plants a corresponding excess of heterozygotes. The results for coupling are the same as those for repulsion.

In the case of Oenothera lamarckiana, which Geerts (16) has proved to be semi-sterile in pollen and embryosacs, we may use the same hypothesis as for the Stizolobium crosses; in which case the fertile combinations, K_2l_2 and k_2L_2, perish as embryos, and only the semi-sterile plants, $KkLl$, survive, the proportions in the second generation with regard to any factor B which is linked with L being, for either coupling or repulsion,

$$B_2 : Bb : b_2$$
$$mn : (m^2+n^2) : mn.$$

This gives a large excess of heterozygotes. We get precisely the same result as regards linkage if we take up the alternative (and perhaps more probable) hypothesis of a pair of allelomorphs, Aa, one of which is lethal to the pollen grains which contain it, and the other lethal to the megaspores having it. In this case, however, a separate factor pair, C_2 and c_2, must be regarded as responsible for the death of half the embryos.

In the double-throwing stock (Matthiola) which gives about equal numbers of singles and doubles, the facts (40) may, I think, be met by the hypothesis that this plant, in addition to being heterozygous for a factor E (double plants having c_2), differs from the normal wild form in that the factor E has undergone a mutation to E^1, E^1 being lethal to pollen grains. Then any factor B (white-flower color as opposed to cream) linked with E^1, will give, in the progeny of the heterozygote E^1eBb,

Plants with	B_2 : Bb : b_2
Normal flowers.........	mn : m^2+n^2 : mn
Neuter double flowers...	n^2 : $2mn$: m^2

This gives (with close coupling) many Bb and very few B_2 and b_2 plants among the singles, and mostly b_2 plants with few Bb among the doubles (40).

Some extensive investigations of the mortality of pollen grains in known and suspected hybrids have been made lately, especially by Jeffrey (21 and 22), Dorsey (13), Standish (43), Hoar (19), and Cole (10). Further work of a quantitative nature on the amount and inheritance of this mortality, and on the state of the embryosacs of these hybrids, is needed before a factorial hypothesis can be applied. There are several distinct causes for empty pollen grains (and for aborted embryosacs, which, however, are not readily counted). (1) There is a mortality due to accidents of environment; in which case the lethal effect is usually different in different flowers on the same plant, or in different plants of the same homozygous line, or at different times of the year. Cold, at a critical period of pollen formation, in the spring or fall, affects the pollen of some tropical plants; as Stizolobium, or cotton (1). This mortality is apparently not selective, and presumably does not affect the ratios of zygotes. (2) There is a partial mortality of pollen grains due to zygotic factors, which factors I have found cause the death of usually a small fraction of the pollen grains in certain fertile and semi-sterile lines from Stizolobium crosses. This tendency is inherited, but is apparently random, not selective. (3) The whole (or nearly the whole) of the pollen of a plant may perish by the action of zygotic factors, as in the sweet-pea with empty anthers. In these cases the abortion is not selective. (4) Lethal factors, or combinations of factors, acting on the haploid generation may cause semi-sterility; that is, the death of half the pollen grains and half the em-

bryosacs. In this case the elimination is selective, and the F_2 ratios are altered for fertile and semi-sterile plants, and for cases of linkage. (5) There may be selective partial elimination of pollen grains or embryosacs by sublethal factors (though this has not yet been proved for any one case). It would of course immediately affect the F_2 ratios and linkage, if at all extensive.

Since two or more of these causes of mortality of pollen grains and embryosacs may occur in the same plant, even to determine for instance whether a hybrid plant is precisely semi-sterile or not may require an examination of the pollen from many flowers, and in some cases (as in Citrus species hybrids) for several seasons in succession.

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Improvement of Labor Conditions for Women in France

Early in the war, it became realized in France that the absence of men and heavy responsibilities on women were causing many conditions to exist which could not but be detrimental to the race. One of the chief of these was work in factories for women and more especially night work. Although laws regulating such labor have been passed, frequent exemptions have been granted. A circular dated June 29, 1916, states *Commerce Reports,* prescribed certain limits for the employment of women at night. Then gradually employers themselves undertook to restrict further the night employment of female labor, with the result that an investigation begun by the Ministry of Labor on May 31, 1917, shows that female labor at night has been reduced to almost insignificant proportions.

It is reported that improvements have been made everywhere in the conditions and circumstances affecting the night work of the women. Husband and wife are employed at the same hours, so that they may take their meals together; there are eight-hour shifts, so that night work is required of each shift only one week in three; women are entrusted with the lighter kinds of work; the rest periods have been made more numerous; female workers living in the same quarter of the town are grouped together in the factory.

In the belief that further modifications might be made without jeopardizing the national defense, the committee in charge of female labor conditions gave expression to a number of desiderata to be put into effect. It is urged that no girls under eighteen years of age be employed at night, and that night work for women in no case be permitted to last longer than ten hours. It is also urged that night work for females of all ages, tolerated since the beginning of the war by suspension of the rules on this subject, shall be suppressed whenever the conditions affecting the supply of raw materials, of motive power, and of labor are such as to make it possible to obtain the same output by means of day labor alone; that when the output of a factory is decreased night work be curtailed first of all for women; that whenever the hours of labor are decreased, the reduction apply first to night work; that, so far as possible, mobilized married laborers be sent by preference to shops and factories in which their wives are employed.

AN ANOMALY OF WHEAT ANTHERS

S. A. ANTHONY, *Chicago, Ill.*

ON a head of wheat grown in a greenhouse of the United States Department of Agriculture, at Arlington, Virginia, an interesting anomaly of the anthers was observed, which, as far as the writer knows, has not been previously reported.

The literature of teratology is very large, especially the observation of cases of metamorphosis of anthers into petals in composite flowers, and in the transformation of the integuments of the ovary into leaves. Teratologic phenomena in plants may arise from different causes. The usual consequence is the metamorphosis of a sexual organ into a vegetative one. Whether these are of pathologic or physiological origin, the cause can hardly be separated from a physico-chemical stimulus of the protoplasm arising from the production or liberation of substances (hormones) which produce the metamorphosis.

According to Goebel, the stamen of the Gramineae (Goebel, K. Vergleichende Entwicklungs geschichte der Pflanzenorgane, p. 118; Goebel K. Organographie der Pflanzen, 1913, p. 329) is a sporophyll originated by the transformation of a primordium (*Anlage*) of a foliage leaf. It produces the microspores, and before the appearance of the spore-forming tissue is a four-angled body, in every angle of which a sporangium is differentiated. The two pollen-sacs with the filament form the anther, being united by the connective.

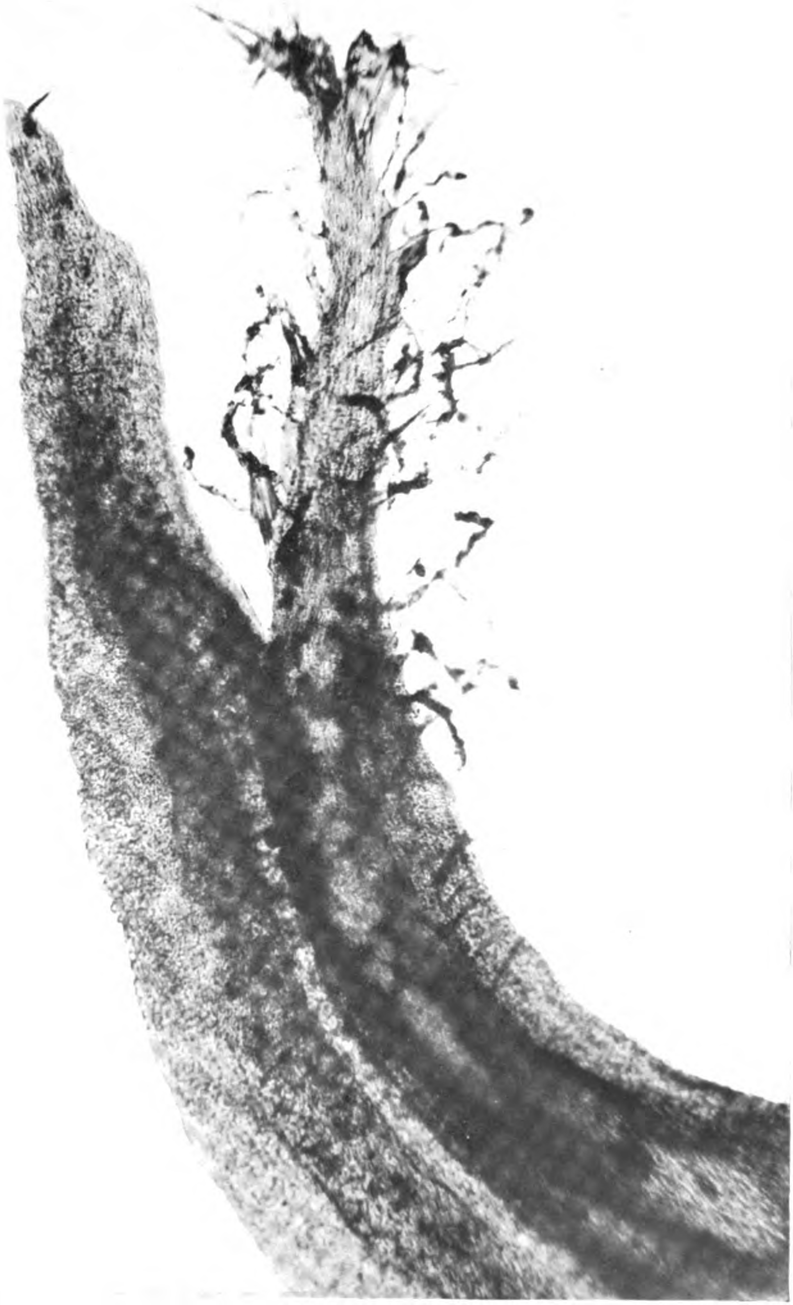
In Phyllody the stamens are transformed either to foliage leaves or to petals. Goebel (*loc. cit.*) explains this through the action of the factors which cause the transformation of the leaf primordium into a petal, on the primordium of the stamen, causing the sporophyll to transform before the formation of the pollen-sacs.

In a case coming under the notice of the writer, however, only half of the sporophyll was transformed, and not into a leaf or a petal, but into a process bearing stigma hairs. As can be seen in Fig. 6, one-half the anther tip is transformed into a stylus with stigma hairs, practically a complete stigma. In Fig. 7 the transformation is very incomplete and the hairs formed suggest the toothing of the awn. It has been previously noted in barley that the awn is physiologically correlated to the stigma. In the modified stamen the filament invariably unites with the affected part and forms practically one body.

That the explanation given for Phyllody cannot be completely applied in this case is obvious, because genetically the stigma hairs belong to the carpels, and are very closely related to the embryo forming leaf structure.

That an organ-forming substance of a different organ may have influenced the Anlage of the sporophyll is possible, as suggested by Sachs and Loele. (Sachs Ueber Wachstums periode und Bildungsreize. Flora, 1893, p. 217. See also J. Loele, Bot. Gazette, 1915, Vol. 60, p. 249; Vol. 62, p. 293; 1917, Vol. 63, p. 25.) Goebel (*loc. cit.*) considers hormones and changes of the concentration of the protoplasmic fluids as possible explanations.

The fact that this anomaly has been found in the greenhouse suggests that abnormal physical factors of temperature or moisture may have a bearing on this phenomenon.



AN ABNORMAL ANTHER

Tip of an anther, one half of which is normal; the other half is transformed into a stigma branch. (Fig. 6.)

AN ANOMALOUS ANTHER OF WHEAT

An anther similar to that in Fig. 6 transformed to a lesser degree. Note the attachment of the filament to the modified half. (Fig. 7.)

RECIPROCAL BREEDING IN TOMATOES

Study Made in Order to Compare Relative Values of the Two Directions of the Cross—Certain Characters in Plants Correlated with Weight and Size of Fruits

BYRON D. HALSTED

Botanist, N. J. College Agricultural Experiment Station, New Brunswick, N. J.

FOR THE purpose of studying the relative values of the two directions of the cross in reciprocal breeding two kinds of tomatoes were selected that had at least four contrasting characters. The Dandy Dwarf variety (158) with its dwarf plants, having yellow foliage and coarse leaves and red fruits was combined with the Yellow Cherry (183), a standard sort with green foliage and fine leaves and yellow fruit. The union in two opposite directions was between but one plant of each kind, that is, the plant a–a, Dandy Dwarf, was bred upon the plant $b \frac{a}{(b)}$ representing the Yellow Cherry, and the reciprocal was between the same two plants, namely $\frac{b}{a}$.

During the season of 1917 the study was mainly between the two sets of plants of the second generation, but, as is the general rule, a small number of F_1 plants as well as of the two parental kinds were grown.

The Dandy Dwarf is a fair average of the kinds that are of low stature with short branches and thickly-set leaves. It bears red fruits that are broader than long and weigh near 24 grams. The Yellow Cherry is a tall-growing variety, with green foliage, fine leaves and yellow fruits of near a fourth (5.4 gr.) of the weight of the Dandy Dwarf, and not far from a half as long and broad as the red fruits of its breeding mate, as shown below:

	Plant	Foliage	Leaf	Fruit	Weight	Length	Width
					Gr.	*Mm.*	*Mm.*
Dandy Dwarf (158).....	Dwarf	Yellow	Coarse	Red	23.80	27.70	37.40
Yellow Cherry (183).....	Standard	Green	Fine	Yellow	5.40	16.70	19.40

The F_1 plants were all standard, green, fine, red and with the following fruit-weights and sizes:

	Gr.	*Mm.*	*Mm.*
1. Dandy Dwarf upon Yellow Cherry F1..	16.29	25.99	32.80
2. Yellow Cherry upon Dandy Dwarf F1..	16.47	28.42	34.02

The F_1 plants, with Yellow Cherry as the seed parent yield lighter and smaller fruits than the reciprocal. The greatest difference is in the length, namely 9.35%. In other words, the fruit characters of the seed parent are approached in both unions.

Records of each F_2 plant were taken for the following characters, namely, type of plant (whether standard or dwarf) the color of foliage (whether green or yellow) the kind of leaves (whether fine or coarse "potato-leaved") color of fruit, (whether red or yellow). Five fruits from each plant were weighed singly and measured for both length and width. The fruits were taken at random when fully ripe, and the picking and measuring were done by a student who had no knowledge of the purpose the records were afterwards to serve.

From the records 126 F_2 plants have been taken from each of the two sets. In one of the crosses this was the total number that had each of the several items in full and without flaw. In the reciprocal the first 126 plants with complete record were used.

Table I shows the results for the four

pair of characters that bred as dominants and recessives.

The theoretical Mendelian ratio calls for 94.5 for the dominant, and 31.5 for the recessive characters. Table I shows that the standard plants are much in

TABLE I

Direction of the cross	Number of plants	Plants		Foliage		Leaves		Fruit	
		Standard	Dwarf	Green	Yellow	Fine	Coarse	Red	Yellow
1. Dandy Dwarf upon Yellow Cherry F_2..............	126	106	20	96	30	91	35	96	30
2. Yellow Cherry upon Dandy Dwarf F_2........	126	106	20	99	27	85	41	97	29

TABLE II

	Plants	Number of plants	Green foliage, per cent	Yellow foliage, per cent
1. Dandy Dwarf upon Yellow Cherry....	Standard	106	74.5	25.5
	Dwarf	20	85.0	15.0
2. Yellow Cherry upon Dandy Dwarf....	Standard	106	81.1	18.9
	Dwarf	20	65.0	35.0
Both Crosses combined..................	Standard	212	77.8	22.2
	Dwarf	40	75.0	25.0

TABLE III

	Plants	Number	Fine leaves, per cent	Coarse leaves, per cent
1. Dandy Dwarf upon Yellow Cherry.....	Standard	106	69.8	30.2
	Dwarf	20	85.0	15.0
2. Yellow Cherry upon Dandy Dwarf.....	Standard	106	70.9	29.1
	Dwarf	20	60.0	40.0
Both crosses combined	Standard	212	70.4	30.6
	Dwarf	40	72.5	27.5

TABLE IV

	Plants	Number	Red fruited, per cent	Yellow fruited, per cent
1. Dandy Dwarf upon Yellow Cherry.....	Standard	106	76.4	23.6
	Dwarf	20	75.0	25.0
2. Yellow Cherry upon Dandy Dwarf.....	Standard	106	74.5	25.5
	Dwarf	20	90.0	10.0
Both crosses combined	Standard	212	75.5	24.5
	Dwarf	40	82.5	17.5

TABLE V

Parents and direction of cross	Plants		Foliage		Leaves		Fruit	
	Standard	Dwarf	Green	Yellow	Fine	Coarse	Red	Yellow
1. Dandy Dwarf upon Yellow Cherry...............	84.1	15.9	79.8	20.2	77.4	22.2	75.7	24.3
2. Yellow Cherry upon Dandy Dwarf............	84.1	15.9	73.1	26.9	69.5	30.5	82.3	17.7

TABLE VI

	Number of plants	Fruit		
		Weight	Length	Width
		Gr.	*Mm.*	*Mm.*
1. Dandy Dwarf upon Yellow Cherry...............	126	13.19	23.13	29.49
2. Yellow Cherry upon Dandy Dwarf................	126	12.34	22.30	28.42

excess of the theoretical ratio and there is no difference in this respect between the two sets of F_2 plants. The only other wide deviation from the theoretical requirement is in the excess of plants with coarse foliage, and particularly in the second cross, where the ratio is near to two to one.

The standard and dwarf plants are associated with the two types of foliage as shown (Table II).

Table II shows that the ratios for type of foliage are quite close to the theoretical per cent when both crosses are computed together, for the dwarfs it being fully attained; but the results are markedly different from this when considered separately. The percentage of plants with green foliage is very high for the first cross, and here the seed parent is the Yellow Cherry with its green foliage. On the other hand, in the reciprocal the percentage of the plants with green foliage falls to 65, and here the seed parent is the Dandy Dwarf, which has yellow foliage.

The standard and dwarf plants are associated with the two types of leaves as shown (Table III).

Table III shows that the ratios for type of leaves are not far from the theoretical percentages when both crosses are computed together, but the results are quite otherwise when the crosses are considered separately. The percentage of dwarf plants with coarse leaves is very low when the seed parent is the Yellow Cherry, and contrariwise correspondingly high when the Dandy Dwarf is the seed parent.

The standard and dwarf plants are associated with the two types of fruit colors as shown in Table IV.

Table IV shows that the ratios for fruit colors are close to the theoretical, excepting among the dwarf plants in cross (2) in which the plants with red fruits make up 90% and the Dandy Dwarf (red fruited) is the seed parent.

A summary of the last three tables is shown in Table V.

Table V shows that in cross one (1) the green foliage and fine leaves are in excess of the theoretical percentages, while the yellow fruited plants are very close to the number called for by the Mendelian rule. In other words, the cross with Yellow Cherry as the seed parent shows in the offspring the Mendelian characters of this parent in percentages generally in excess of the theoretical number. Contrariwise the reciprocal cross (2) shows the characters of its seed parent, the Dandy Dwarf, in

numbers that are in excess of the requirements of theory. In short, the results suggest that the seed parent in both directions of the cross may have a more potent influence than its mate.

We now pass to a consideration of the fruit characters other than color namely, the weight, length and width.

Table VI shows that fruits are heavier and larger in the cross with Dandy Dwarf upon Yellow Cherry, than its reciprocal. In other words, the pollen parent is apparently the more potent for the fruit characters here under consideration.

The relation of the size of the plant (standard or dwarf) to the weight, length and width of the fruits is shown below (Table VII).

Table VII shows that when the fruits, five each, of all the 252 plants are combined, the average weight of those produced by standard plants is much fess than is the average weight of the lruits borne by the dwarf plants. A similar association obtains with size of fruit, but the differences for length and width are less, namely 8.70% for length and 4.82% for width.

The relation of the color of the foliage (green or yellow) to the weight and size of the fruits is shown in Table VIII.

Table VIII shows that the plants with green foliage produced heavier fruits, than did the plants with yellow foliage, the difference being 3.87%. In length of fruit the corresponding difference is 4.69%, but in width there is no marked difference.

The relation of the type of leaf (fine and coarse) to the weight and size of the fruits is shown in Table IX.

Table IX shows that the plants with coarse leaves produced heavier and larger fruits than did the plants with fine leaves. In weight the difference

TABLE VII

	Plant	*Weight, Gr.*	*Length, Mm.*	*Width, Mm.*
1. Dandy Dwarf upon Yellow Cherry..	Standard	12.69	22.83	29.06
	Dwarf	15.88	24.66	29.49
2. Yellow Cherry upon Dandy Dwarf..	Standard	12.03	21.97	27.91
	Dwarf	14.18	24.04	30.03
Both reciprocals combined............	Standard	12.36	22.40	28.39
	Dwarf	14.53	24.35	29.78

TABLE VIII

	Foliage	*Plants*	*Weight, Gr.*	*Length, Mm.*	*Width, Mm.*
1. Dandy Dwarf upon Yellow Cherry...	Green	96	13.36	23.43	29.58
	Yellow	30	12.62	22.15	29.22
2. Yellow Cherry upon Dandy Dwarf...	Green	99	12.44	22.42	28.17
	Yellow	27	12.20	21.69	28.57
Both reciprocals combined.............	Green	195	12.90	22.93	28.88
	Yellow	57	12.41	21.92	28.90

TABLE IX

	Leaved	*Plants*	*Weight, Gr.*	*Length, Mm.*	*Width, Mm.*
1. Dandy Dwarf upon Yellow Cherry...	Fine	91	12.91	22.79	29.26
	Coarse	35	13.95	24.01	30.09
2. Yellow Cherry upon Dandy Dwarf...	Fine	85	11.64	22.03	27.51
	Coarse	41	13.88	22.76	29.89
Both reciprocals combined.............	Fine	176	12.28	22.44	28.39
	Coarse	76	13.92	23.39	29.89

TABLE X

	Fruited	*Plants*	*Weight, Gr.*	*Length, Mm.*	*Width, Mm.*
1. Dandy Dwarf upon Yellow Cherry...	Red	96	13.42	23.25	29.69
	Yellow	30	12.49	23.06	28.48
2. Yellow Cherry upon Dandy Dwarf...	Red	97	13.97	22.61	28.71
	Yellow	29	10.44	21.27	26.76
Both seciprocal combined..............	Red	193	13.70	22.88	29.21
	Yellow	59	11.47	22.17	27.80

is 13.43%, in length 4.23% and in width 5.28%.

The relation of the color of the fruit (red or yellow) to the size and weight of the fruit is given in Table X.

Table X shows that the plants with red fruits produced heavier and larger tomatoes than did the plants with yellow fruits, the difference in weight being 11.59% and in length and width 3.20% and 4.88% respectively.

The green foliage carries more chlorophyll than yellow foliage and therefore it may be expected to have the greater photosynthetic power; and this may account for the differences in weight and size of fruits. Excepting this single factor the series of tables shows that the Mendelian characters, associated in the Dandy Dwarf, are correlated with the larger fruit. This is in the face of the downward pull of the factor for yellow foliage.

	Number	*Weight, gr.*	*Length, mm.*	*Width, mm.*
The extracted Yellow Cherry.	31	11.31	22.07	27.61
The extracted Dandy Dwarf..	4	17.00	25.20	33.60

From this table it is computed that the excess of weight and size of the fruits from plants of the Dandy Dwarf type over those of the Yellow Cherry are 50.31, 14.18 and 22.48 per cent respectively.

As frequently shown in plant breeding, it is here found that the fruits of the F_1 plants exceed in weight and size those of the F_2 plants, as shown below:

	Weight, gr.	*Length, mm.*	*Width, mm.*
F_1.....	16.38	27.21	34.41
F_2.....	13.45	23.38	29.09

It might be more to the point to make the comparison with only the F_2 plants that show the Mendelian characters of F_1. There are 40 of these in one cross and 38 in its reciprocal, and the results for these 78 plants—extracted F_1 if one may so call them, are as follows:

Weight, gr.	*Length, mm.*	*Width, mm.*
12.15	22.57	28.42

It is seen that the differences between the F_1 and the F_2 are here greater than when all the F_2 plants are considered.

The present study of the F_2 of a true reciprocal cross of the two widely differing varieties of tomatoes suggests, that for the Mendelian characters the seed parent in both combinations shows a more potent influence over the offspring than does its mate, the pollen parent. But with characters of fruit weight and size requiring averages for an expression of results, the evidence points in the opposite direction, namely that the pollen parent is the more influential.

When the results of both crosses are combined, it is noted that the fruits of greater weight and size are produced by: (1) Dwarf plants, (2) green-foliage plants, (3) coarse-leaved plants, (4) red-fruited plants. The extracted Dandy Dwarf plants, so far as the Mendelian characters are concerned, had unusually large fruits and contrariwise the extracted Yellow Cherry plants for their segregating characters had comparatively small fruits.

Proposed South African Agricultural Census

The announcement is made in *Commerce Reports* that a census is soon to be taken of all agricultural resources in the Union of South Africa. The census is to be exhaustive and will embrace live stock, cereals, dairy products, viticulture, the area of farms, the number of agricultural employees, irrigation of land, afforestation, and such matters as will be necessary to afford complete information on those subjects. Provision is to be made for the returns to show the ages and classes of stock, sheep, ostriches, poultry, horses, mules, and asses. Data on stock diseases and losses from droughts will be collected, and farm implements are to be enumerated, while at the same time all phases of wine cultivation will be classified.

A DRY BLOOD-ORANGE STRAIN

A. D. SHAMEL, *Riverside, Cal.*

THE Ruby blood orange variety (*citrus sinensis Osbeck*), was introduced into California from Florida. The trees of this variety have been long known to produce variable fruits, but so far as known, no systematic study of these bud variations was made until those begun by the writer in the season of 1916-1917. A very productive and commercially profitable ten-acre orchard of this variety located near Corona, Cal., was selected for the purpose of carrying on individual tree and fruit studies. The trees are about twenty-four years old and are in fine physical condition. Individual tree records of production are being secured from all of the trees in this orchard, and detailed performance records made from a few select trees. It is not the purpose of the writer to describe the work at this time. It is his desire, however, to call attention to one of the many interesting cases of bud variation existing in this orchard. As a whole there has been found to be more frequent instances of striking bud variations in the trees of this variety than in those of any other citrus variety studied thus far.

SPORT ATTRACTED ATTENTION

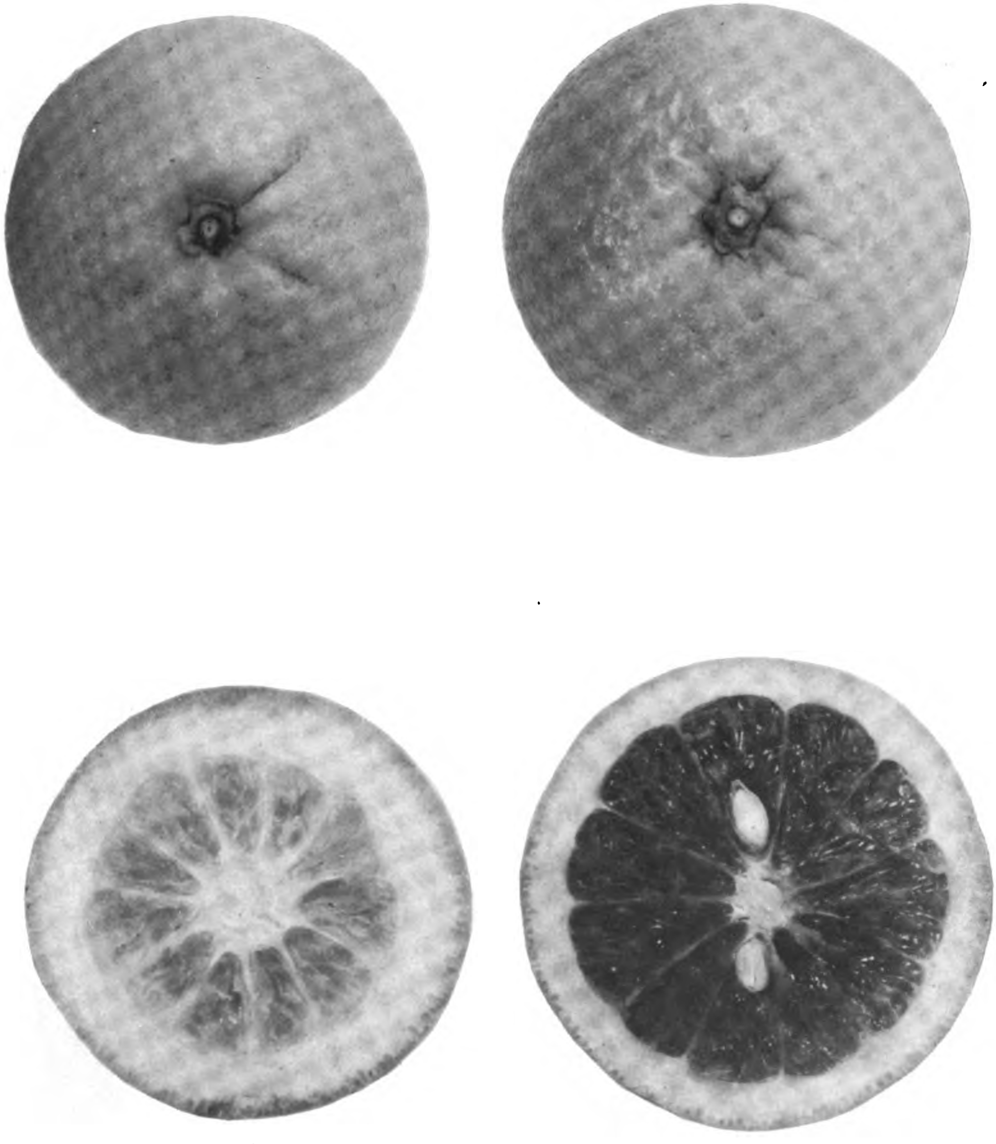
During the first tree census observations in the Ruby blood orchard, amongst the very many variable fruits discovered, one in particular has made a lasting impression in the mind of the writer, his associates, and the visitors to this interesting orchard. It was first discovered as a large limb sport in a typical Ruby blood tree. This large limb protruding from near the top of the tree attracted attention because of a different appearance in foliage characteristics from that of the remainder of the tree. In part, this difference was caused by the narrower and more lanceolate shaped leaves than is characteristic of the normal Ruby blood leaves. The branches of this limb also possessed a somewhat different habit of growth than that of the branches on other limbs of this tree. The fruits borne by the limb sport did not appear, at first glance, to be particularly different in general appearance from the ordinary Ruby blood oranges.

AN ENTIRELY DRY ORANGE.

When one of the limb-sport fruits was cut open, very striking differences were found from the characteristics of the normal Ruby blood orange. The rind was found to be very thick, about double that of the normal fruits. Instead of having a rich blood-like color, the fruit from the limb-sport was straw-colored. Instead of bursting with an abundance of juice, as was the case with normal fruits borne by other limbs on this tree, there was no juice in this fruit. Strenuous efforts to squeeze out even a little juice failed to find a single drop. In other words it was a dry orange.

All of the fruits, seventy-six in number, borne by this limb were cut. Except in the case of five fruits, where one or a few cells contained blood red juice, all of them proved to be similar to the first one cut. An example of the dry orange from this limb in comparison with a normal Ruby blood fruit from this tree is shown in Fig. 8. While the color differences cannot be adequately shown by a photograph some idea of the differences in color, thickness of rind, character of rag and other characteristics can be seen in this illustration.

Further studies of the trees in this orchard revealed the fact that there existed many limb sports bearing dry oranges. About one hundred such limbs were found in the preliminary study of the orchard. In some cases the limbs were large and bore many dry fruits. In other instances the limbs were small and bore only a few dry



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DRY BLOOD ORANGES

Typical fruits from a variable Ruby blood orange tree. Fruit 1, dry Ruby blood orange; Fruit 2, Ruby blood orange. These two fruits were borne by a tree grown from a single bud. The dry fruit is one of 76 borne by a limb sport of this tree during the season of 1916–17. (Fig. 8.)

A DRY BLOOD ORANGE TREE

A close-up view of a section of a dry Ruby blood orange tree showing cross-sections of a typical dry Ruby blood orange. (Fig. 9.)

fruits. Occasionally normal Ruby blood oranges were found on the limbs bearing dry fruits. In some other cases certain sections or cells in the dry fruits contained normal Ruby blood juice.

ENTIRE TREES BEAR DRY FRUITS.

While studying the limb sports bearing dry oranges, the discovery was made that several entire trees in this orchard bore dry fruits. Some of these trees were fairly prolific, bearing several boxes of fruits each. Heretofore, these dry fruits, from the limb sports and from the entire trees, had been included in the regular pick and pack from the orchard, owing to the lack of knowledge concerning the characteristics of the dry fruits. No doubt the consumers who found these fruits in their purchases were disappointed. Since the discovery of the dry limb and tree strain, all of the limbs and trees bearing dry fruits, except those reserved for experimental study, have been pruned out by the owner of the orchard. Hereafter, the dry fruits will not be commonly found in the pack from this orchard.

In most of the trees bearing dry oranges, one or more small branches were found bearing normal Ruby blood fruits, and in some cases other types of blood oranges. Occasionally, single Ruby blood oranges were found in the dry trees, as well as other variable fruits. Also in normal Ruby blood trees, single dry fruits or small branches bearing several dry oranges, were frequently found by the writer and his associates.

DRY ORANGE SPORT DANGEROUS.

Summing up our observations on the dry Ruby blood orange strain in the orchard where these studies are being carried on; entire trees, large and small limb sports bearing dry fruits and individual dry oranges, were found to be of frequent occurrence. In the dry Ruby blood trees and limbs, normal juicy Ruby blood oranges were found occasionally. The dry Ruby blood orange strain is a bud variation of the Ruby blood variety, and commercially is not only worthless but dangerous to the reputation of the crops from orchards containing these dry fruit sports. Until recently the dry fruits have usually been included in the regular pack from the orchard. Now the dry limb and tree variations, except those reserved for further study, have been eliminated in the orchard under observation.

A New Eugenics Organization Founded in Brazil

Expressing a desire that their country should not lag behind the march of science, the medical fraternity of São Paulo, Brazil, has founded a society devoted to the physical and moral improvement of the human race, which is known as the *Sociedade Eugenica de São Paulo*. The inaugural meeting was held under the auspices of the Society of Medicine and Surgery and was attended by a large and enthusiastic audience, says the *Correio Paulistano*.

After speeches explaining the plans of the eugenists by Dr. Renato Kehl and Dr. Olegario de Moura, election of officers was held. The following were elected:

Honorary presidents, Dr. Augustino José de Sousa Lima and Dr. Amancio de Carvalho; president, Dr. Arnaldo Vieira de Carvalho; vice-president, Dr. Olegario de Moura; secretary, Dr. Renato Kehl; vice-secretaries, Dr. Th. de Alvarenga and Dr. Xavier da Silverira; treasurer, Dr. Argemiro Siqueira.

PIGMENTATION IN GUINEA-PIG HAIR

Microscopical as Well as Chemical Studies Reveal Many Differences Between the Black and Red Colors—Genetic Investigation Reveals but a Single Difference—the Problem is Suggested of Explaining the Many Observed Differences as Results of a Single Fundamental Physiological Difference

HARRISON R. HUNT, *West Virginia University*

AND

SEWALL WRIGHT, *Bureau of Animal Industry, Washington, D. C.*

IN RECENT years many interesting facts have been discovered concerning the inheritance of coat color in guinea-pigs. It seems to the writers that the time is now ripe to correlate these facts of heredity with the color, form, and chemical constitution of the pigments which impart the color to the different forms of guinea-pig hair. Progress in science is frequently made by attacking a problem from a new angle. Such a correlation as the one just mentioned should throw some light on the physiology of pigment formation in mammals.

In all, twenty-eight samples of guinea-pig hair have been studied so far. These were dehydrated in absolute alcohol, cleared in xylol, imbedded in paraffin, sectioned and mounted in the usual way, and studied, unstained, with the oil immersion.

The cortical, or peripheral, and the medullary, or central, regions of the guinea-pig's hair present characteristic differences. The medulla contains extensive communicating air spaces (see figures), and its substance stains readily with eosin. The cortical material lacks this reaction with eosin and air spaces are entirely absent. The cuticle forms a thin outer covering for the hair

The color of the hair depends upon two forms of pigment—diffuse and granular. The former lends color to the hair in much the same way that substances in solution may color a solvent. The adjective "granular" sufficiently explains the character of the other kind of pigment.

The color and the distribution of these pigment substances in the medulla and cortex demonstrate some interesting facts in the physiology of pigment formation.

OBSERVATIONS

Black Hair.—The most noteworthy fact in the case of black hair is that both the medulla and the cortex have an abundance of black granular pigment. (Fig. 10.) The cortical granules are short cylindrical rods whose diameters are, roughly, half or two-thirds their length. The average length is about 0.8 of a micron. Their long axes lie lengthwise of the hair. The medullary granules vary in size and shape, the smallest ones being about 0.2 of a micron in diameter and the largest approximately 3½ micra in their greatest dimension.

In the same samples of hair, the granules are often more closely aggregated in cross-sections of small diameter than in larger sections. The smaller cross-sections were probably cut nearer than the larger ones to the distal ends of the hair. Since the tips of the hairs are usually darker in color than the bases, one would expect to find the condition just described—more granules near the tips.

Sepia Hair.—In sepia hair the granules are black. They vary considerably in size and are abundant in both cortex and medulla. The cortical granules as in black hair are predominantly short bacillus-like rods, oriented with their long axes parallel to the long axis of the hair. The distribution and

the number of the granules observed in sepia hair seems to be practically the same as in black hair. However, since black hair is darker than sepia, it certainly must contain a slightly larger amount of black pigment than sepia hair.

Red Hair.—Red hair, like black and sepia, has a large amount of granular pigment in the medulla, but unlike them it has *very few* granules in the cortex. As will appear later, this absence of cortical granules is a significant fact.

The granules in red hair vary widely in size and shape. Nearly all are spherical, having a diameter, as accurately as could be computed, of 0.2 to 0.3 micron. It is difficult to see these small ones clearly except when an oil immersion objective is used. The largest granules, which are relatively few in number, are elongated. Some of them are as large as 6 micra x 2 micra, about eighteen times as long as the smallest particles. Between these two extremes is found a great variety of intermediate sizes.

The color of the pigment particles is distinctly yellowish. The difference in color between them and the pigment in black hair is very clearly seen when one compares sections of the two kinds of hair under the same conditions of illumination and magnification.

Diffuse yellowish pigment is abundant in the cortex of some hairs. Probably it is present in every hair but can be seen only in those sections where it is relatively concentrated. It is most dense around the medulla, fading away to invisibility near the surface of the hair.

Yellow Hair.—The number of granules in the cortex of yellow hair is extremely small. The medulla contains a greater quantity of granular pigment, but even this is considerably less than in the medulla of red hair. Comparing red with yellow guinea pigs, one finds that the yellow color is really a dilute red. The difference in the quantity of granular pigment observed in the hair sections may explain this color dilution.

The granules in the yellow hair vary markedly in size and color. There are a few of the large yellow type such as are found in red hair. Of the smaller granules, a large part seem to be as *black* as the smaller ones in black hair, while the rest are yellowish. Probably these black granules are more highly oxidized melanin than the yellow ones. Yellow hair is sometimes slightly sooty in appearance. The black granules are undoubtedly responsible for this sootiness.

A slightly yellowish tint in the cortex of a few hairs suggests that diffuse yellow pigment may be present, but is not always visible on account of the thinness of the sections.

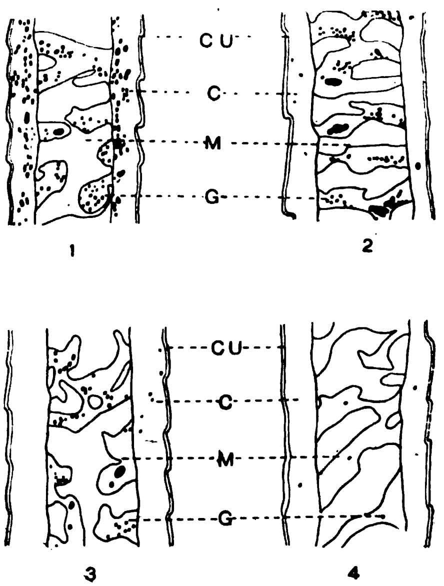
Cream Hair.—The medulla and cortex of cream hair contain a very few granules, apparently black, of approximately the size of the granules in red hair. The sections do not furnish evidence of diffuse pigment, but the dark color and the small number of the pigment granules can hardly account for the color of the hair, which is not black but cream. Therefore diffuse yellow pigment is probably present, but in such small quantities that in the sections it does not visibly alter the color of transmitted light.

DISCUSSION OF OBSERVATIONS

The preceding discussion has brought out a number of distinct ways in which red hair differs from black. First, there are differences in the character of the pigment. Black hair contains only granules and these are dark in color. Red hair contains both granules and diffuse pigment, and these are light colored. There is a difference in distribution; in black hair, granules are abundant in both cortex and medulla, while in red hair they are found almost exclusively in the medulla.

Next there is a difference in the effect produced when the same genetic factors are introduced into black and red stocks of guinea pigs. The case of most interest here is the effect of introducing grades of albinism. Complete albinism reduces both black and red to white. the dilution factor, an allelomorph of albinism, when introduced into black stock, produces sepia, a dark brown color, which grades into black. No

certain distinction could be observed under the microscope between samples of sepia and of black. When the same dilution factor is introduced into reds, the color is changed to yellow or cream, and the sections show a marked reduction in the number of granules as compared with red hair. With a still lower grade of imperfect albinism, red is wholly reduced to white, while black is still only very slightly affected. This greater susceptibility of red to the influence of dilution factors is the rule among mammals.



MAGNIFIED HAIRS

Longitudinal sections of guinea-pig hairs magnified 1550 diameters.

Fig. 1, Black hair; Fig. 2, red hair; Fig. 3, yellow hair; Fig. 4, cream hair; CU, cuticle; C, cortex; M, medulla; G, pigment granule. (Fig. 10.)

To these differences between black and red may be added certain ones observed by other workers. Miss Durham[1] found a distinct difference in solubility of the pigments. Dilute alkali dissolved red pigment easily but black hardly at all. Gortner[2] observed a pronounced chemical difference. Black pigment from several sources contained considerable iron, while red pigment contained virtually none. Onslow[3] discovered a difference in the enzyme content of the skins of black and yellow rabbits. He could extract a peroxidase from the skins of black rabbits but not from yellow. With this peroxidase he could produce dark pigment resembling melanin.

At first sight it seems necessary to suppose that black and red guinea pigs differ from each other by many physiological factors in order to account for these many differences. But there is probably only one primary physiological difference between black and red hair, because a single genetic factor is enough to effect the change. All the observed differences are, in some way, direct or indirect effects of this primary dfference.

It is generally agreed that melanin pigment is produced by the oxidation, through the influence of oxidizing enzymes, of protein metabolic products such as tyrosin. The simplest explanation of the difference between black and red hair seems to be that a certain specific enzyme (enzyme II), which is present in black, is absent in red. This enzyme increases the oxidizing power of another, more fundamental, enzyme (enzyme I) whose presence is necessary for the production of ***any*** pigment. (Wright.)[4] The more thorough oxidation of the chromogens in the case of blacks is probably responsible for the differences in color between black and red hairs, the more thoroughly granular nature, and the decreased solubility of black pigment.

The difference in iron content, noted by Gortner, seems at first to indicate a specific difference in the chromogens of blacks and reds, as well as in the enzymes producing them. But the following explanation is possible. The chromogens oxidized in the red hair are also oxidized in black, but in addition iron-containing chromogens are oxidized in the latter.

The presence of granular pigment in

[1] Durham, F. M., 1904. *Proc. Roy. Soc London.*, 74:310–313.
[2] Gortner, R. A., 1911. *Biochem. Bull.*, 1:207–215. 1912. ***Proc. Soc. Exp. Biol. and Med.***, 9:3–4.
[3] Onslow, H., 1915. *Proc. Roy. Soc.*, B–89:36–58.
[4] Wright, S., 1917. JOUR. HEREDITY, 8:224-235.

the cortex of black and sepia hair and its almost complete absence in red and yellow, shows that the constitution of the cortex imposes some obstacle in the way of cortical pigment production in red and yellow hair. The enzyme for black overcomes this obstacle; therefore pigment appears in the cortex of black and sepia hair. It seems likely that this obstacle is the slowing up of the oxidation of chromogens in the cortex. This inhibiting action of the cortex is similar to the effect which the dilution factors have upon pigment production. The dilution factors reduce very little the quantity of pigment in black hair, but considerably diminish the amount in red. *Thus it seems plausible that there is some characteristic peculiarity of the cortex of guinea-pig hair which diminishes the quantity of cortical granular pigment in much the same way as the dilution factors reduce the total granular pigment content.*

Budding Incompatible Cottons.

An experiment has come to light in the field notes of the late R. M. Meade which should be of interest to plant breeders. Mr. Meade has been trying for several years to secure hybrids between American Upland cotton, *Gossypium hirsuum,* and two Asiatic species, *G. herbaceum* and *G. indicum.* From the standpoint of fertile seeds these attempts proved to be unsuccessful but in many instances the cross-pollinated fruits remained on the plants for several days longer than those not pollinated, indicating that initial growth had been stimulated by the application of foreign pollen.

That growth was started seemed to mean that fertilization might have taken place and that complete development was prevented by some form of chemical incompatibility that caused the shedding of the young bolls. Mr. Meade ingeniously planned to overcome this obstacle by budding one species upon the other with the idea that the sap of the stock would exert an influence upon the chemical composition of the floral organs of the budwood. No difficulties were encountered in getting buds of American Upland varieties to grow on Asiatic stock and vice versa and several successfully budded plants were secured. Unfortunately the plants were budded so late in the season that only one of the resulting branches produced flowers and this at a time when no flowers were open on the stock plant.

That the sap of the stock may alter the chemical composition of the budded branches was shown by an experiment in budding two distinct Upland varieties. The variety used for budwood was Willet's Red Leaf. This variety has dark red foliage and stems, which are very distinct in color from those of normal green varieties. The stock was a normal green variety called Trice. Several buds of the Willets's Red Leaf were inserted on the Trice stock; these buds developed rapidly, producing large well-formed leaves and branches. The first leaves on the young budded branches were red in color like the plant from which the bud came but the succeeding leaves became lighter and lighter in shade until at the end of the season they were only half as dark as those of the parental plant which were all dark red. This fact certainly seems to support Mr. Meade's hypothesis that the chemical composition of budded branches might be influenced through the stock, and leaves open the possibility of accomplishing the hybridization of American Upland and Asiatic species of cotton.

A more adequate investigation of this interesting phenomenon is highly desirable. It is hoped that this method of overcoming cross sterility, the testing of which was interrupted by Mr. Meade's untimely death, may be of interest to other investigators.

SOME OBSERVATIONS ON MONKEYS

Striking Affinities Apparent Between Homo and Simia, Both Mentally and Morphologically—Although Certain Differences Hold Good in the Mean, Abnormal Specimens of Homo May be Found Who Show Many Supposed Criterion of Simianism

DR. R. W. SHUFELDT, C. M. Z. S., *Washington, D. C.*

AMONG the many interesting books of the late Prof. St. George Mivart stands the very excellent little volume "Lessons in Elementary Anatomy," which appeared in 1877, and which is a most useful treatise, carrying many instructive illustrations. At the close of this work Professor Mivart says: "Having now completed our elementary investigation and exposition of the various organs and parts which make up man's body, and having noted the more important differences which the corresponding structures may present in other vertebrate animals, it may be well, shortly, to recapitulate some of the leading distinctions in a different sequence and arrangement, in order to bring out more clearly not only the peculiarities, but also the affinities evidenced by various anatomical relations between the body of man and those of other vertebrates."

The results throughout anatomical literature along this line of inquiry and comparison, will stand for the advantage man has reaped, in all ages, from just such investigations, when they have been correctly and intelligently made and employed. Mivart, in the little work above mentioned, first contrasted many of the points in the skeleton of man with what we find in fishes. In a similar manner comparisons were made with the salient points in the anatomy of the batrachians, the reptiles, the birds, the monotremes, the marsupials, and the mammals; finally, his last table sets forth how man differs from all members of his order, except the three highest genera, the orang (*Simia*), the gorilla and chimpanzee (*Troglodytes*), and the gibbon (*Hylobates*)—that is, with respect to his anatomy. In this he enters more extensively than into the other comparisons he makes; there are thirty-five points recorded in the list, wherein man differs from the highest apes, and five wherein he differs from all members of his order.

MANY POINTS CONTRADICTED

These comparisons I have gone carefully over many times, not infrequently with the actual material at hand. From these perusals I am convinced that Mivart must have compared only such osteological and other characters as occur in the skeleton and general organization of the very highest types of men with such corresponding ones as had been brought to light in the simians during the time he wrote and before—or about half a century ago. As a matter of fact, among the very lowest races of men—and in abnormal specimens—we meet with examples which will contradict nearly every point Mivart attempts to make in the final tabulation referred to above. If we confine ourselves to the skull alone, it will be seen that this is true. I was convinced of this about a year ago, when I carefully examined and compared some 20,000 human skulls, of all races, in the collection of the United States National Museum at Washington.[1] To refer to a few of these, I may

[1] This comparison forms the basis of an extensive memoir, with many photographic and line-drawing illustrations, which has been accepted for publication by the Medical Department of the Army.

A MACAQUE MONKEY

Especially worthy of note is the form of the ear in this specimen, since it is pointed posteriorly. In rare cases in man a point of the ear may be found turned in. (Fig. 11.)

say that it is not true that "the cranio-facial angle varies from 90° to 120°," nor that the "superciliary ridges are little developed;" neither is "a long styloid process" always present in the skulls of *Homo*.

As a matter of fact, while the characters referred to by Mivart as exemplifying the anatomical organization of man, contrasted with that of the simians or apes, are generally to be found in the higher races of men—more particularly the highest races—they are frequently absent in lower ones, as for instance among negroes, native Australians, and the like, where we meet with examples that are quite ape-like in some parts of their anatomical organization. As for that, I have examined negro skulls wherein the jaws were very large and powerful; the nasal spine almost aborted; the superciliary ridges prominently developed; the maxillo-premaxillary suture present in the adult; the cranio-facial angle very small, and so on through the category. These characters, as found in the skulls of negroes, are fully set forth in my recent work on "The American Negro," and in numerous articles on the subject, published during the past thirty-five years.

ANTHROPOIDEA DIFFER WIDELY

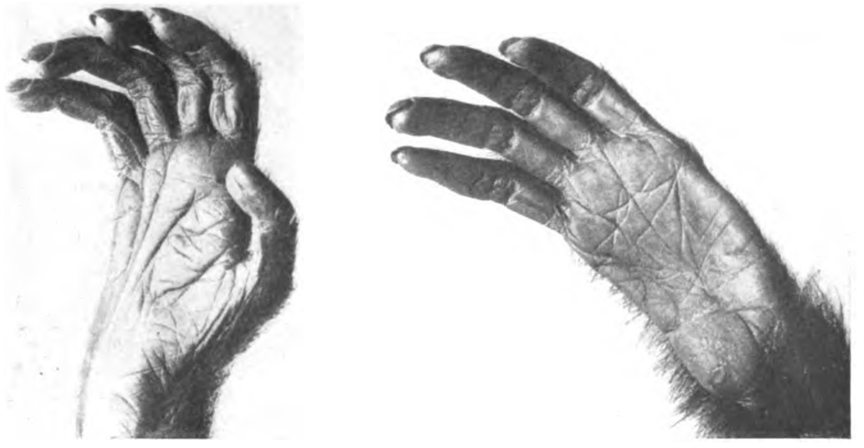
Anatomically, the *Anthropoidea* differ widely among themselves—that is, the higher apes, the monkeys, gibbons, and marmosets; this is also true of many races of men. This is quite apart from their anatomy or physical organization; for in that matter the morphology of the lowest form of monkey is quite as complex as that of the highest type of man. To be sure, the brain of the latter possesses the greater number of convolutions, and there are other structural differences; but, part for part, the organization of the one is reproduced in the other. Some structures may be

A SOUTH AMERICAN TYPE

Head of a black spider monkey (*Ateles paniscus*); en face. Adult male. (FIG. 12.)

ONE OF THE SMALLER APES

Same specimen as shown in Fig. 12 seen on right profile. (Fig. 13.)



HAND AND FOOT OF ATELES

Palmar aspect of left hand of Black Spider Monkey shown in right-hand cut, with aborted thumb. The left-hand cut shows the right foot of the same individual. This graphically resembles a human hand. The great toe, which is well developed, has the appearance of a finger, and the palmar surface extends backwards more than might be anticipated. The nails resemble greatly those of the human hand. Photograph natural size. (Fig. 14).

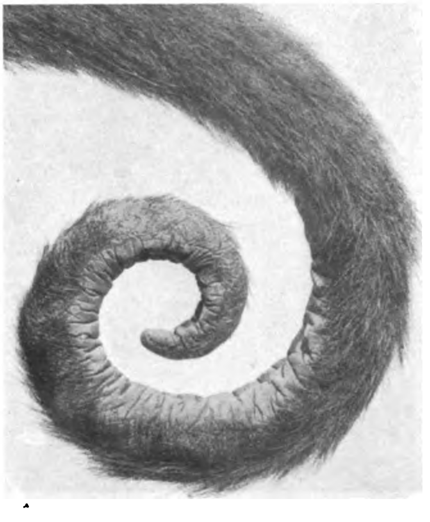
missing in man's anatomy, and present in the ape's; but this in no way contradicts the aforesaid statement. So, too, for the organs themselves as a whole—the eye, or the ear, or the tongue of a monkey is just as perfect and complex as are the corresponding organs in man.

Elliot, in his great work (three volumes) on "A Review of the Primates," says: "In this review the orangoutang is placed lowest in the scale or farthest from man; and the genus Pongo is considered to possess but one species certainly, and one very doubtful. The author is fully aware that this opinion is by no means shared by some of his colleagues, who would recognize a large number of species; but after examining all the material of orangs contained in all of the large museums of the world, the writer was able to discover no character that would prove the existence of more than one species. The opinions as to the position the orang should occupy in reference to man have varied greatly, yet despite the views of so great an authority as that of his friend, the late Sir Richard Owen, who would place the orang before the gorilla in its relation to man, the author, from the result of his own studies and the evidence produced by others, considers that the testimony in its entirety shows that the gorilla, low as he may be in the scale of intelligence, has more of an affinity for man than the orang, while both are far exceeded in man-like qualities by the chimpanzee." (Vol. i, p. xxvii.)

Passing next to a brief consideration of the mental and physical attributes of apes, monkeys, and their various near congeners, as compared with the corresponding ones in man, I may truthfully state that simply tons of books and articles have been published on that subject. Notwithstanding this fact, how very, very few there are, even in the highly intellectual classes, that can intelligently discuss the mental and physical differences that exist between man and the apes and their near kin. As a matter of fact, articulate speech, as possessed by the former, is the main distinctive character between them. Even this distinction is not wholly true, for all apes and all monkeys have a language of their own, which has been largely translated by students of it. As to the emotions, apes possess them as well as man, and, with respect to some of them quite as pronounced. There is no question but that all the *senses* are as well developed in apes as in man, as sight, hearing, smell, and so on.

Long ago, Professor Huxley said that "a man born dumb, notwithstanding his great cerebral mass and his inheritance of strong intellectual instincts, would be capable of few higher intellectual manifestations than an Orang or a Chimpanzee, if he were confined to the society of a few dumb associates. And yet there might not be the slightest discernible difference between his brain and that of a highly intelligent and cultivated person. The dumbness might be the result of a defective structure of the mouth, or of the tongue, or a mere defective innervation of these parts; or it might result from congenital deafness, caused by some minute defect of the internal ear, which only a careful anatomist could discover.

"The argument, that because there is an immense difference between a man's intelligence and an ape's, therefore there must be an equally immense difference between their brains, appears to me to be as well based as the reasoning by which one should endeavor to prove that, because there is a 'great gulf' between a watch that keeps accurate time and another that will not go at all, there is therefore a great structural hiatus between the two watches. A hair in the balance-wheel, a little rust on a pinion, a bend in a tooth of the escapement, a something so slight that only the practiced eye of the watchmaker can discover it, may be the source of all the difference."



ATELES' FIFTH HAND

Some monkeys are afforded practically an additional hand by a prehensile tail such as this. Although it is not used for tactile examination of objects, for purposes of locomotion it serves as well as any other member. However, it is probable that such an equipment is genetically inferior to the two hands and two feet supplied man. (Fig. 15.)

Through the kindness of Mr. Edward S. Schmid, of Washington, D. C., who presented me with the material, I am enabled to offer, as illustrations to the present article, various reproductions of photographs which I have made of two species of monkeys, and which aim to show facial expressions as well as the morphology of hands, feet, and tail. In Fig. 11 we have the portrait of the common Macaque monkey of India (*Macacus rhesus*), a form which stands between the African mangabeys and the baboons. Special attention is invited to the form of its ear and its general physiognomy. Note that the ear is *pointed* posteriorly. In the human species we sometimes meet with cases where this point is present and turned down. Darwin gives an excellent account of this structure in his work on "The Descent of Man" (pp. 15–17), and I have personally seen some excellent examples of it, the best one being in the case of a very low, black negro in New Orleans. This point is not present in the ears of all apes and monkeys, among others it is absent in the large, black spider monkey (*Ateles paniscus*), here shown in Figs. 12 and 13. In the foetal Orang it is directed upward.

In passing I may say that the black spider monkey belongs in a group wherein the tail is prehensile, and to a large extent fulfills the function of a fifth hand. Its form is well shown in Fig. 15, and this structure, as well as the hand and foot portrayed in Fig. 14, all belonged to the black spider monkey mentioned above (Figs. 12 and 13). This species gets its name, *Ateles*, from the fact that it possesses no thumb, that digit of the hand having, in time, entirely aborted. (Right hand cut of Fig. 14.) The lines of the palmar surfaces of the hands and feet in monkeys is an interesting field for comparative study, but up to the present time but little has been published on the subject.

PENETRATION OF SCION BY STOCK

G. B. Patvardhan

Assistant Professor of Botany, Agricultural College, Poona, India

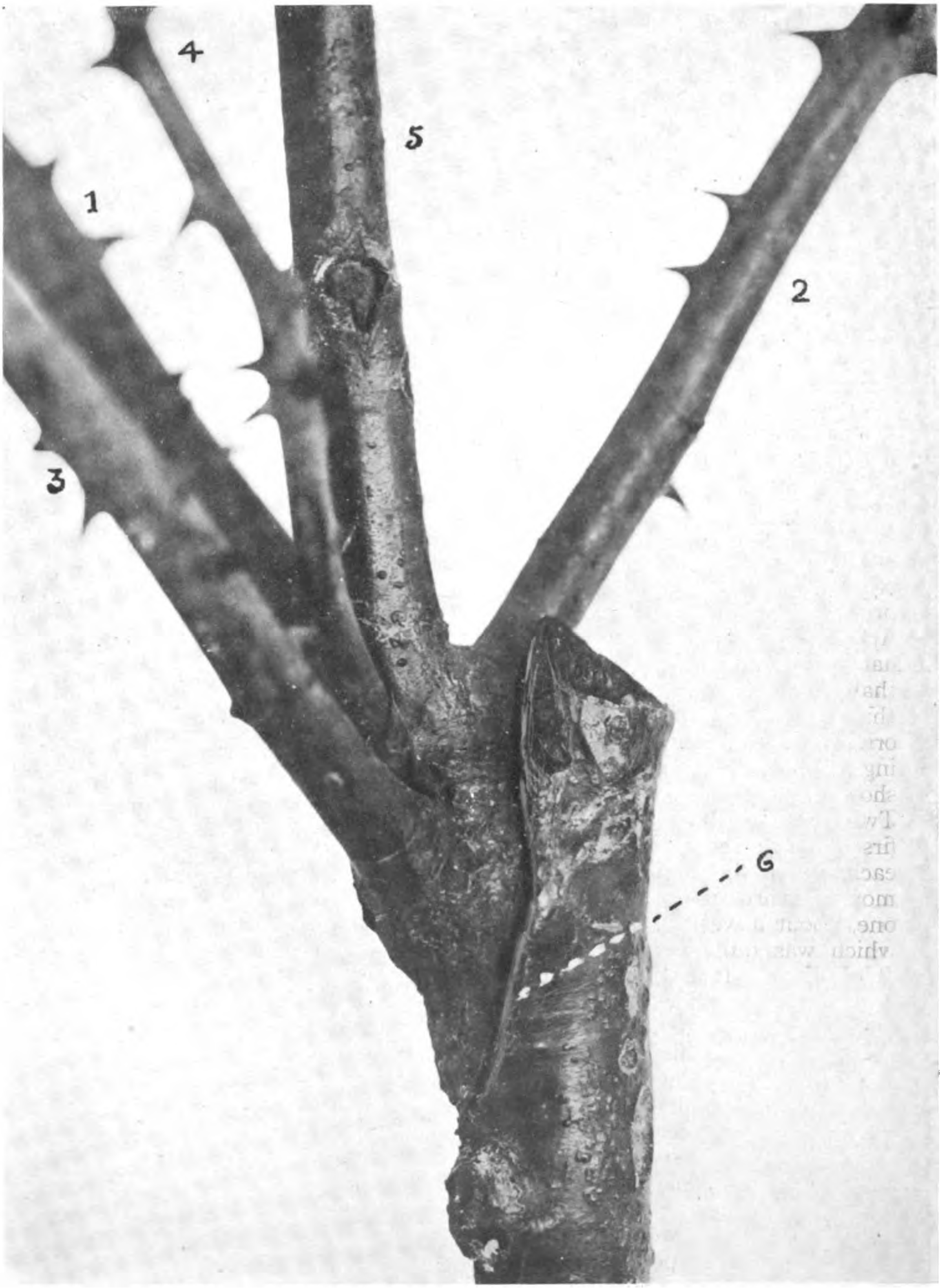
DURING a casual observation of a few rose plants growing in my compound, in the month of August, 1917, I happened to notice one budded plant with 5 shoots emanating from the region where the original bud was inserted on the stock. The scion is a *Paul Neron* rose. The plant was originally grown in the Ganeshkhind Botanical Gardens, Kirkee, India. The bud was inserted on a one-year-old stock about the month of February, 1916. The scion was pruned once about the month of April, 1917. On a very careful examination of the five shoots, it was found that the center one, which was older, thicker and riper than the rest, was the original scion and three of the remaining four were shoots which clearly showed the characters of Edward rose. Two of these shoots 2, and 3, when I first noticed them, showed one flower each, which was undoubtedly our common Edward rose, while the center one, about a week later, showed a bud which was quite similar to that of a *Paul Neron*. It is regrettable that the fully expanded flower from this bud was, however, pilfered away by somebody before the flower could be observed by me. The plant was taken to the Agricultural College and shown to Dr. Burns, Economic Botanist to the Government of Bombay, before photographing, which was done on September 8, 1917, just before the bud appeared. The flowers of the Edward rose dropped their petals during transit to the college for photographing.

ORIGIN OF SHOOTS PROBLEMATICAL

The question of interest is—how did four shoots of the stock appear from the budwood of the scion? Usually vigorous outgrowths from the stock appear below the point of insertion of the scion and these are usually rubbed away, so that any depletion of the supply of sap to the scion is prevented and all that is sucked up by the stock, is available for the use of the scion. In this case the shoots of the Edward rose are about 9 or 10 weeks old (by August-September, 1917). They seem to be derived from adventitious buds which might have appeared on the stock below the budwood, even after latter had become well established and forced their way through the tissue of the scion. An examination of the photograph shows that the shoots have clearly originated from the budwood within the area of the callus formed at the margin of the slit made for budding, and not from any doubtful region such as the margin of the slit or elsewhere closer.

I am adding the following after observing the plant for a month and a half since noting the above. Shoots Nos. 2 and 3 flowered again on October 25, 1917. The flowers were Edward roses. This confirms previous statement regarding shoots Nos. 2 and 3. Shoot No. 1 has grown very long and vigorously. It is expected to flower in the next few days and confirm its nature.

From the comparative vigor of growth, I conclude that Nos. 1, 2 and 3 are shoots of Edward roses derived from the stock and No. 4 is *Paul Neron,* which has made no further growth since first photographing. Similarly No. 5 also has made no further growth, both being held in check by the superior power of Edward shoots of drawing or sucking up more sap than could be done by the scion from the stock.



AN UNUSUAL BUD FREAK

The budded region of the plant showing the positions and origin of shoots. The shoots 1, 2 and 3 belong to the Edward Rose variety and 5 is the scion. The swollen and projecting portion is the original budwood. The raised edge of the bark of the stock is shown by 6. (Fig. 16.)

STRIKING ORANGE BUD VARIATIONS

A. D. SHAMEL, *Riverside, Cal.*

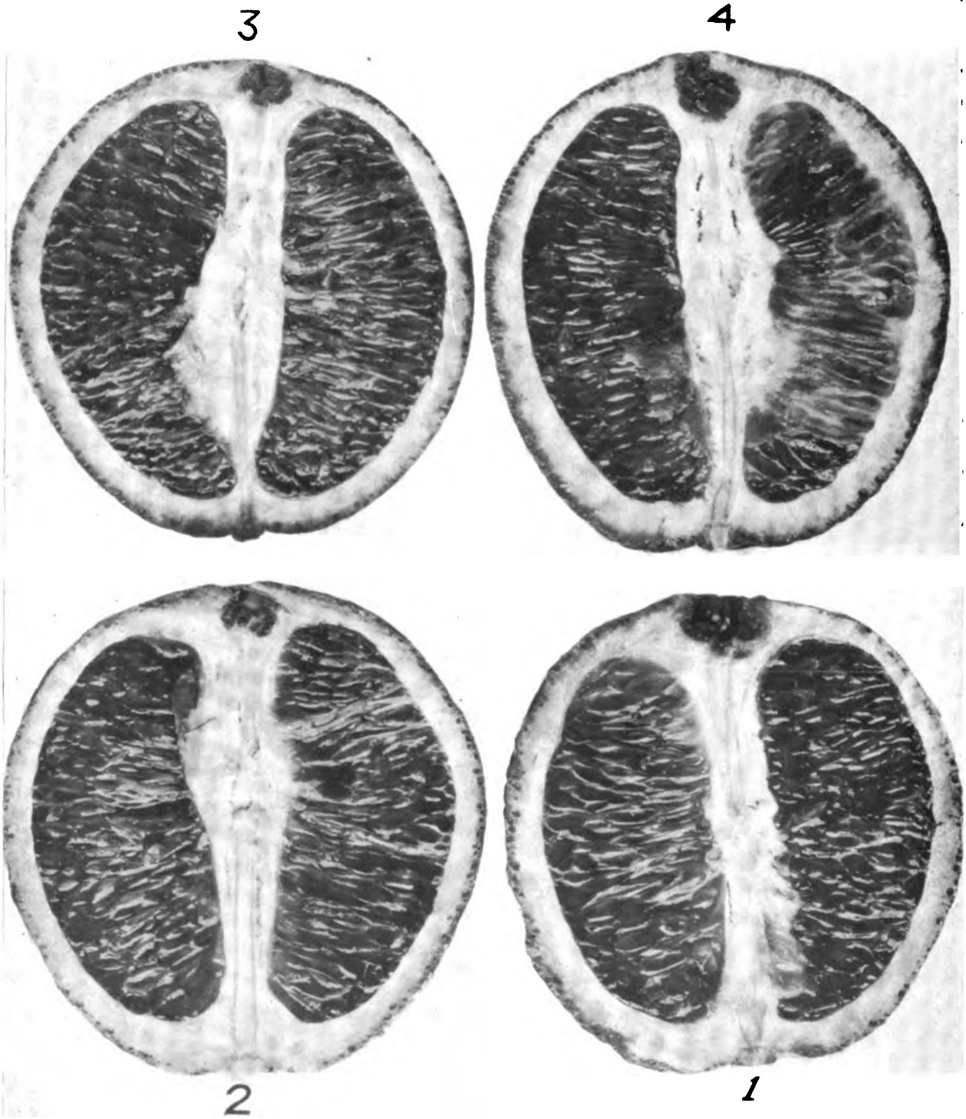
A "THOMSON strain" tree of the Washington navel orange variety in one of the individual tree performance record plats on the Eureka ranch near Riverside, Cal., has for eight years consistently produced striking bud variations. Typical fruits of two of these variations and one of the typical Thomson oranges are shown in the accompanying illustrations. It has been discovered that the Thomson strain is a bud variation of the Washington navel variety. The Washington fruits, borne by a limb in this Thomson tree, may be considered in the nature of reversions to the parent variety. One of the large limbs bears the corrugated fruits. In this limb occasional Washington and Thomson fruits have been found from time to time.

Propagations of buds secured from fruit-bearing budwood were made from the Washington limb, the limb with the corrugated fruits, and the Thomson limbs, in the spring of 1913. The trees from these propagations came into fruiting for the first time this season, 1917-1918. The young trees have uniformly borne fruits similar to that borne by the parent limbs and the budwood from which they were propagated. In other words three strains have been isolated from the parent tree through bud selection, viz., Washington, Corrugated, and Thomson.

There are certain foliage characteristics of these strains which have been reproduced in the young trees. The young trees of each of these strains have characteristic habits of growth similar to that of mature or full-bearing trees of these strains.

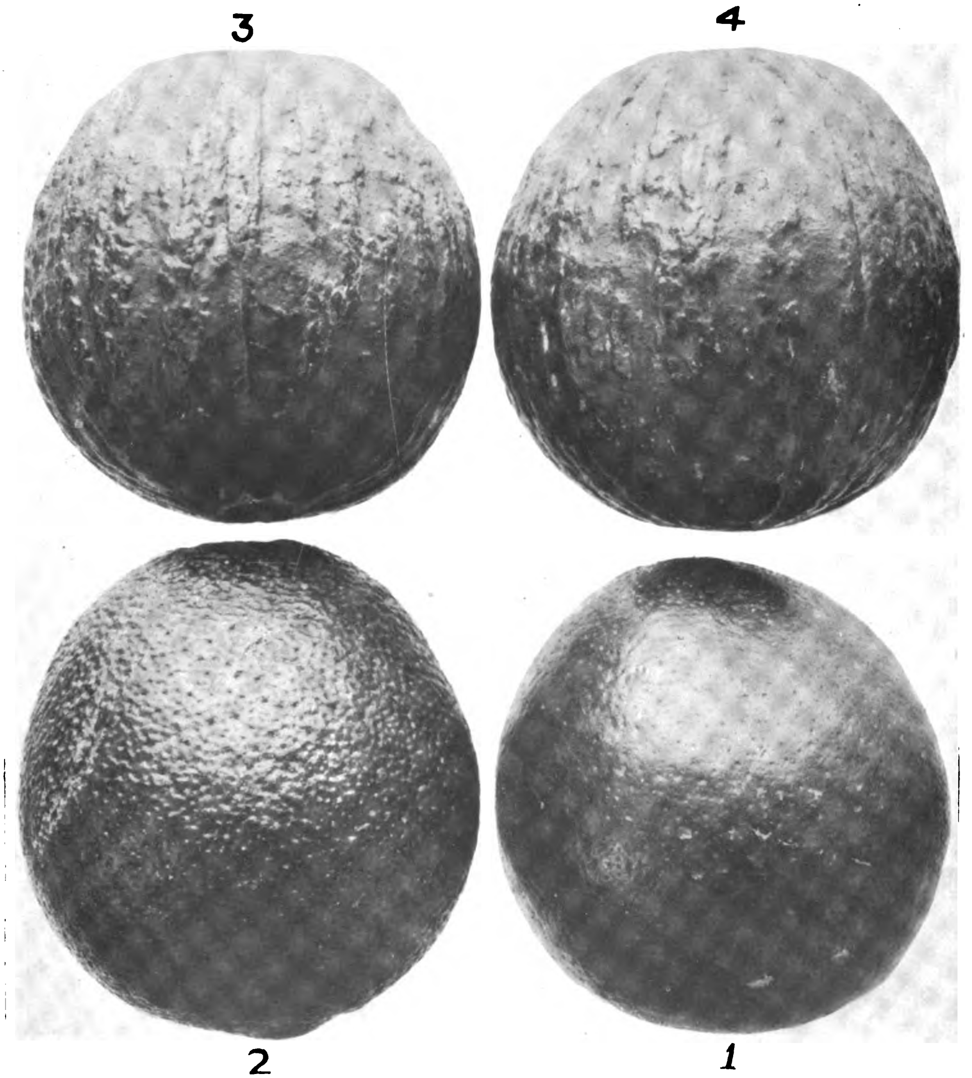
DIFFERENCES OF IMPORTANCE

The very important commercial differences in the value of the fruits of these strains can be easily seen from the photograph of the typical fruits. The differences in rag, juiciness and quality of the juice of these fruits is not so easily shown or described. The Washington fruits have a tender rag, melting in the mouth, an abundance of juice which possesses the rich and high flavor characteristic of the fruits of this variety. The Thomson fruits have a woody or tough rag, are lacking somewhat in juice, and the flavor of the juice is inferior to that of the Washington fruits. The Corrugated fruits have a tender rag, very similar to that of the Washington fruits, but the juice, while abundant in quantity, is lacking in both acid and sugar, resulting in a very inferior quality of fruit. This example is typical of the occurrence of frequent and striking bud variations in citrus varieties. It explains the origin of the many diverse strains of the commercial citrus varieties in California. It explains the presence of the many trees of these strains in the citrus orchards. It also shows the necessity for care in the selection of budwood in order to avoid so far as possible the propagation of bud sports. The selection of parent trees and of fruit-bearing budwood in these trees can be most safely done by means of individual tree performance records and intimate tree knowledge.



SECTIONS OF NAVEL ORANGE TYPES

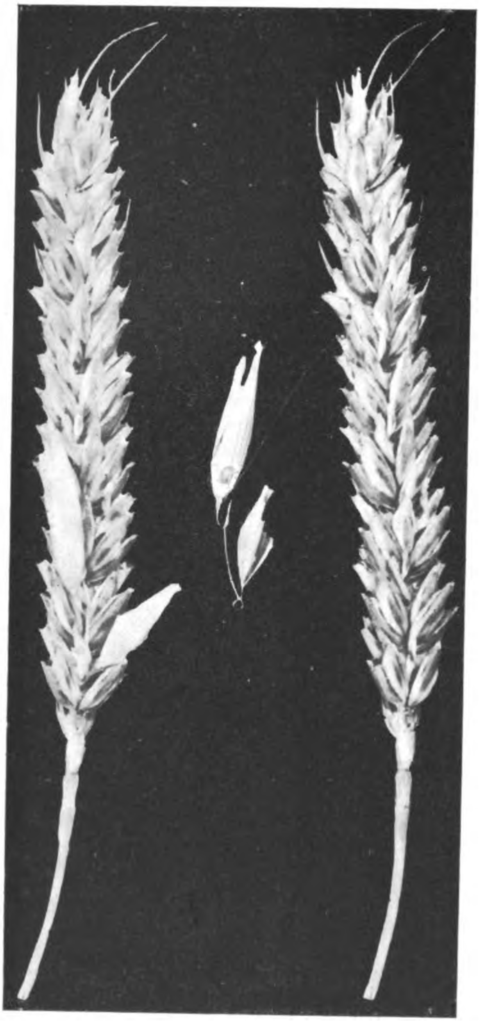
Vertical sections of the oranges shown in Fig. 1. Section 1, Thomson navel orange; section 2, Washington navel orange; sections 3 and 4, corrugated navel oranges. In addition to the difference in rind there are marked differences in the quality of these fruits. The Washington fruit is superior to the others in tenderness of flesh and amount and flavor of juice. (Fig. 17.)



WASHINGTON AND CORRUGATED NAVEL ORANGES

A Thomson strain tree of the Washington navel orange variety in the Eureka orchard near Riverside, California, produced the fruits shown in this photograph. Fruit 1, a typical Thomson navel orange; fruit 2, a typical Washington navel orange; fruits 3 and 4, typical Corrugated navel oranges. The Washington and Corrugated strain fruits are borne by individual limbs. This case is typical of the remarkable and frequent bud variability of the navel orange and other citrus varieties. (Fig. 18.)

NATURE AS A NATURE-FAKER



HOW A FREAK OCCURS

In producing the freak illustrated herewith nature assumed the same rôle as the student of entomology who sought to fool his professor by making up an insect from the parts of several unrelated insects. The specimen was a chance find by a man in northeast Texas. He was honest in his belief that the wheat head had produced two kernels of oats.

The specimen was perfect; the oat pedicels came from the base of the central kernel of one of the lower spikelets of the wheat head, the attachment being completely hidden by the stiff outer glumes crowded together at this point. On the left is shown the wheat head with the oat kernels attached and on the right the results of dissection with the aid of moisture. The oat pedicel was wrapped completely and tightly around the base of the central floret of the wheat spikelet. The opportunity for this queer behavior must have been afforded by the fact that an oat plant grew close to the wheat plant and while the pedicel was very young and sensitive the head of wheat and oats were brought together by some agency, presumably wind. The pedicel behaved as a tendril and upon nearing maturity pulled the oats from the parent oat plant. (Fig. **19**.)

E. P. HUMBERT,
Agricultural Experiment Station,
College Station, Texas.

Food in War Time

FOOD IN WAR TIME, by Graham Lusk, Professor of Physiology, Cornell University Medical College in New York City. Pp. 46. W. B. Saunders Company, Philadelphia.

Dr. Lusk points out admirably well the important fundamentals of food and nutrition and lays down valuable suggestions for a balanced diet of war time foods. This is particularly valuable at the present time, when many are anxious to effect a change of diet in order to comply with rulings of the Food Administration, but find themselves unable to do so satisfactorily. The second chapter deals with calories in common life and presents figures showing calories used per square meter of body surface at different ages and in various occupations. Exhaustive tables are presented showing cost of one thousand calories in various foodstuffs. Eight rules of safety and saving are set forth in the third chapter, which summarize the fundamentals of the discussion, and furnish an easily followed guide toward food habits which will not only follow the rulings of conservation but will also be entirely enjoyable.

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TALCOTT WILLIAMS, Dean of the School of Journalism, Columbia University, New York, N. Y.

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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

MAY—JUNE, 1918

BREEDING NEW CASTOR BEANS

GIRDLING THE CORINTH GRAPE TO MAKE IT GROW

PRODUCING BREAD MAKING WHEATS FOR WARM CLIMATES

COLOR INHERITANCE IN MAMMALS

ORGAN OF THE
AMERICAN·GENETIC·ASSOCIATION
WASHINGTON · D.C.
Printed for Circulation among Members only

WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, coöperative in nature. It is devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

It owns the Journal of Heredity, which is published monthly and sent free to each member.

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Date of issue of this number, May 25, 1918.

MALE AND FEMALE FLOWERS OF THE CASTOR BEAN

The rough horn-like stigmas of the female flowers are shown at the top of the flowering spike. The buds on the lower portion of the spike are those of male flowers. Only one male flower in full bloom is shown. (Slightly magnified.) (Frontispiece.)

BREEDING NEW CASTOR BEANS

Castor Oil Now Becoming of Immense Commercial Importance as Motor Lubricant—Careful Breeding of Varieties Having Desired Attributes Necessary to Produce Best Commercial Seed—Many Characters Show Mendelian Behavior.

ORLAND E. WHITE

Curator of Plant Breeding, Brooklyn Botanic Garden, Brooklyn, N. Y.

THE well-known castor oil is expressed from the seeds of a Euphorbiaceous ornmental plant (*Ricinus communis*), related to our scarlet poinsettias. Hundreds of distinct varieties of this plant are known in the tropics—especially in India, where the bulk of the world's crop is grown. Most treatises roughly divide these numerous varieties into large and small-seeded types, the former producing supposedly less oil and of inferior quality. A collection of several hundred types (see Figs. 1 and 2), commercial and otherwise, assembled from various tropical and sub-tropical regions, discloses the fact that no sharp line can be drawn between the large Zanzibar types, running 450 to 600 beans per pound, and the small Bombay beans, running anywhere from 1,500 to 4,500 beans per pound, depending on the variety. All degrees of intergrades in size of beans exist, these, no doubt, resulting from more or less chance crossing, which wind and insects have brought about during the centuries of its cultivation.

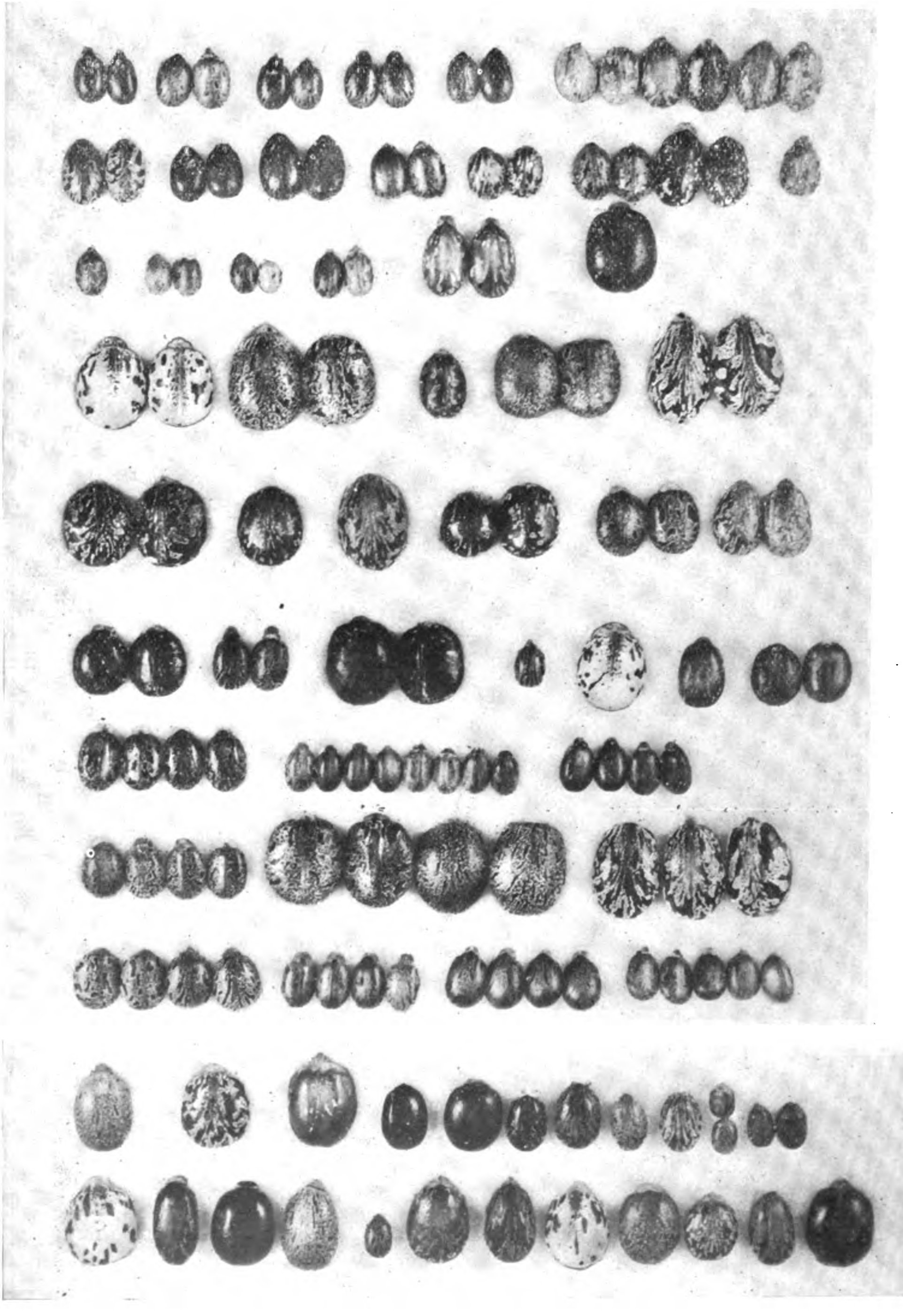
BEANS MAINLY IMPORTED FROM INDIA

Of the million or more bushels of beans annually imported into this country through the port of New York, the bulk come from Madras and Bombay; a few from Mexico, Brazil, Argentine Republic, Java, and China. The Indian beans as they reach our factories are generally a mixture of such small and medium seeded types as are represented in Fig. 2. The large seeded types, shown in the same figure, were said to be Chinese and are grown considerably in Mexico. The oil content of the Indian beans runs as high as 55 per cent, while the large Zanzibar beans give only 35 per cent oil, and of inferior quality because of the increased amount of "acid." Shortly after the Civil War, castor oil bean farming in the United States became a promising local industry in Kansas, Illinois, and other Middle Western States, but overproduction and competition with cheap Hindu labor soon made it unprofitable. Castor oil beans, as late as twelve years ago, were raised commercially in Oklahoma, and the scarcity of imported beans and the increased demand for the oil, due to the war, will probably bring large areas in these sections again into castor oil bean cultivation. Large sandy areas in the Gulf States, now largely waste land, are said to be eminently fitted for this crop. The crop runs anywhere from 10 to 40 bushels per acre, depending largely on the variety planted, the soil, the climate, and the length of frostless season. Even as far north as Iowa, from 15 to 25 bushels per acre have been obtained.

The oil has innumerable uses, chief among these being its value in dyeing cloth, in medicine, and as an aeroplane motor lubricant. Its non-drying, non-gumming properties, and its high density are said to make it especially desirable for lubricating the newly invented Liberty motor. Normally this country uses about 1,000,000 gallons annually, but the war and the increased use of aeroplanes after the war probably will many times increase this amount.

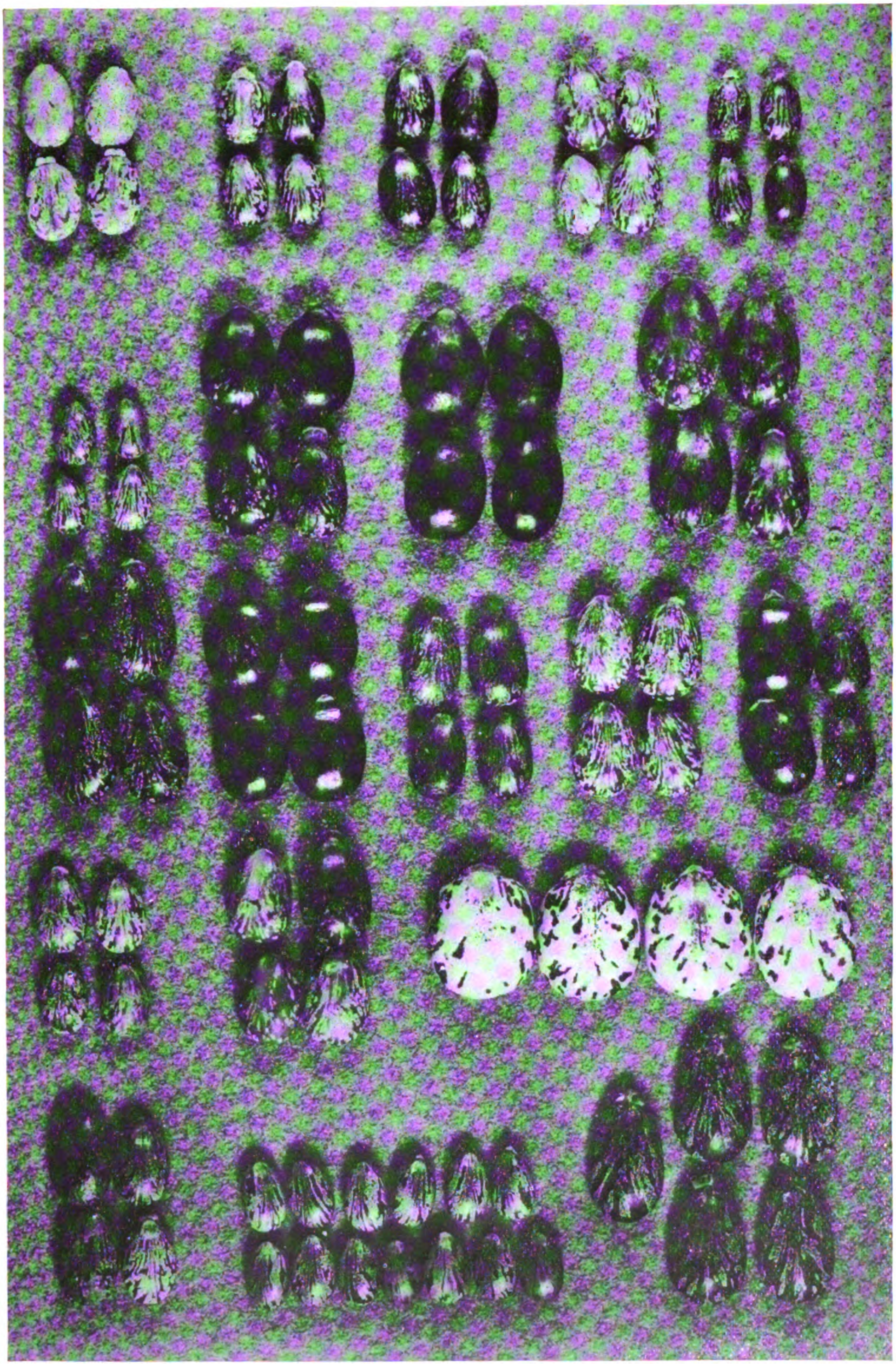
BREEDING OF GOOD TYPES ESSENTIAL

To make commercial castor oil bean growing in this country a permanent industry, requires the breeding of varie-



VARIATION IN SIZE, SHAPE, PATTERN, AND COLORING

Each group in all but the last two rows represents a distinct kind or variety. Often the beans are arranged to show upper and lower surfaces. The very large beans are Zanzibar types with low oil content. In the last two rows, each variety is represented usually by a single bean. These beans are types from Mexico, Italy, Java, Zanzibar, Uganda and Rhodesia. (Reduced one-third.) (Fig. 1.)



COMMERCIAL TYPES OF CASTOR BEANS

Each of the groups represents one type. The first three rows represent commercial types of India. The last two rows are types from Mexico, Java, British West Indies and India. (Natural size.) (Fig. 2)

ties with the highest possible oil content, the smallest amount of the objectionable "acid;" varieties adapted to such waste lands as those of the sandy areas of the Gulf Coast and other sandy regions of the southern United States, and, perhaps, the sandhills of Nebraska; varieties having close, compact, fruiting spikes with thin-walled, spineless, "non-popping" seed capsules. The plants should be prolific in fruiting spikes, early maturing, and bear over a long season. The materials for producing such varietal types already exist among the innumerable forms of castor beans, the main problem being to bring them together into one or more commercial varieties.

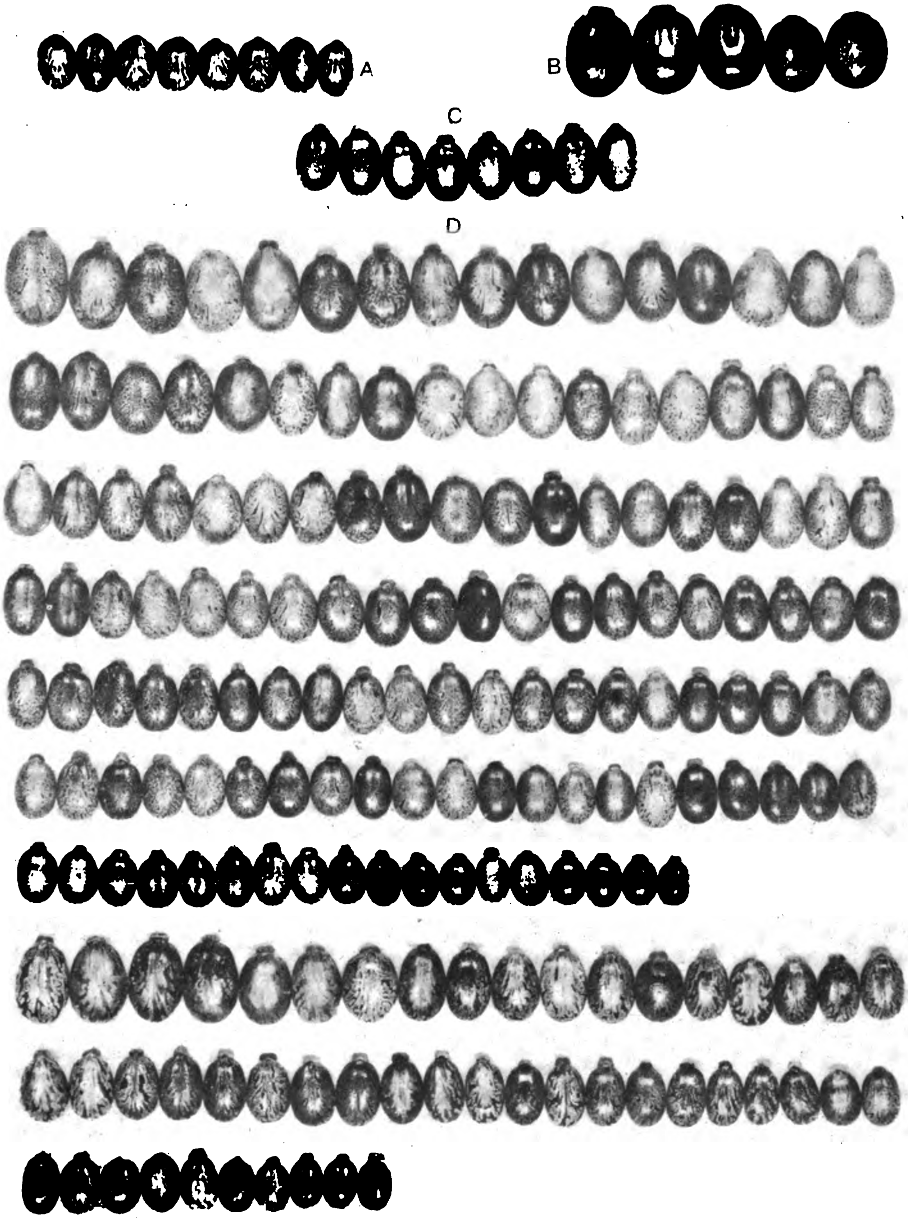
So far as the writer knows, no very serious attempt has been made to do this, although some plant-breeding work and variety testing has been done in Algeria, British West Indies, Egypt, and India. From several years experience, the writer has found the castor oil plant an excellent subject for plant-breeding work. The plants are easily grown, comparatively free from disease, the seeds remain viable for several years with a very high per cent of germination. All the types, even to the most extreme, readily cross, giving fertile F_1 and F_2 hybrids. Some varieties when crossed, give a much larger yield of seed in the F_1 generation, while of other types, as in maize, this is not true. Among the characters showing Mendelian behavior are stem, foliage, and seed coat color, glaucous or non-glaucous plants, "popping" or "non-popping" seed capsules (dehiscent or indehiscent), types of seedcoat mottling, seed size and shape, height of plant, compactness and size of fruiting spike, time of maturity, certain leaf characters, etc. Only a few of these characters have been studied in enough detail so that they may be placed on a factorial basis. Such a character as indehiscent capsules, when combined with thin capsular walls and other characters should be especially valuable in a variety grown for oil, since a large per cent of the seeds are not wasted by the popping of the mature capsules. Also labor is saved, since it is not necessary to harvest the crop once or twice a week in order to avoid loss, as is the case with common popping varieties. This characteristic is easily transferred as apparently not more than two pair of factors are involved.

PLANT IS MONOECIOUS

As is well known, the castor bean plant is monoecious, the male and female flowers appearing on different portions of the same flowering spike (see Frontispiece). Both types of flowers mature at about the same time, the male flowers perhaps slightly earlier. All the flowers, either male or female, of the same spike, do not mature at the same time. The proportion of female flowers destined to produce mature capsules, usually involve a week or so in setting so that the seeds of one spike ripen at about the same time. Square bottomed, light colored manila paper bags are used to cover the inflorescence when selfed seed is desired or when crosses are made. The sacks should be of fair size, as it may be desirable to keep the rapidly lengthening inflorescence covered for a considerable period, until all danger of "adventitious" female flowers appearing and contamination resulting thereby, has been eliminated. After bagging, when selfed seed is desired, the bags should be shaken every few days as the pollen matures, so as to insure plenty of "fruit" setting. In a windy country this may not be necessary, but the writer finds it to be so in his work in Brooklyn.

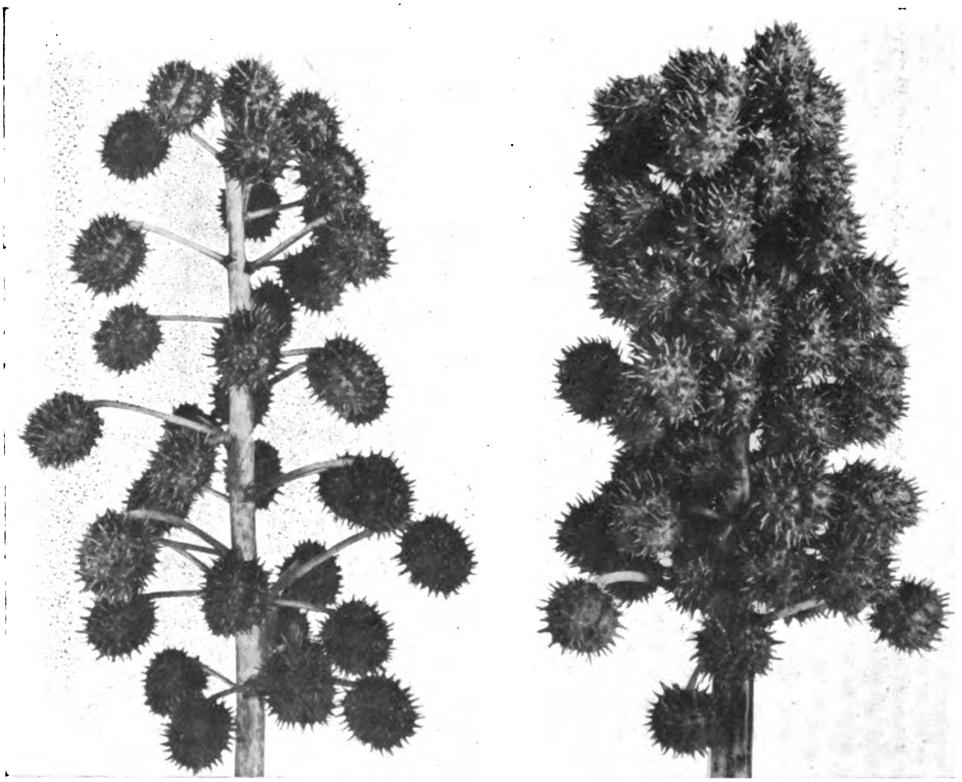
GENERALLY BREED TRUE

Observations based on cultures in the breeding plots at the Brooklyn Botanic Garden show that many of the varieties, much to my surprise (since the castor oil plant is monoecious and wind-pollinated), breed true to many of their most prominent characters immediately. Data from progeny of plants of different varieties, grown close together, indicate that very little cross-fertilization took place (probably not more than 5%), even when conditions appeared most favorable. This may be accounted for, perhaps, by the copious supply of pol-



RESULTS FROM CROSSING DIFFERENT TYPES

Illustrates inheritance of seed dimension and coarse and fine seedcoat mottling. A. Maternal parent. B. Seeds in all respects similar to paternal parent. C. F_1, progeny. Note the uniform appearance both as to size and mottling the F_1, progeny seeds. D. F_2, in progeny. The coarse and fine mottled segregates are arranged in a separate series. In every case, each single bean represents a typical bean from one plant. (Reduced one-third.) (Fig. 3.)



LOOSE AND COMPACT FRUITING SPIKES

The types with compact spikes in general are greater seed producers, and hence of more commercial value. (Fig. 4.)

len of the male flowers, the comparative proximity of the female flowers, and the sheltering effect of the foliage against air currents bearing foreign pollen. The flowers are said to be excellent honey producers for bees, so where these are common one might expect a much greater amount of cross fertilization.

In selection work, such as the isolation of high oil producing types, it seems best and most practical to insure complete isolation by using paper bags as mentioned above. In making crosses, the male flowers may be easily removed without harming the spike and the remaining female flowers. Male flowers usually mature and shed their pollen in early morning. The pollen remains viable for at least a week, when kept in a dry place.

Breeding Sows Before Litters are Weaned

Experiments described in the monthly *Bulletin* of the Ohio Agricultural Experiment Station for May, 1918, would indicate that there is no danger in breeding sows when their litters are from 43 to 56 days of age. Conception seems to take place just as readily, the milk flow is apparently not affected and the pigs seem to thrive just as well as if breeding did not take place until the litter was weaned.

GIRDLING THE CORINTH GRAPE TO MAKE IT BEAR

The Zanth Currant Industry in California—An Early Seedless Raisin Crop—Yearly Girdling at Proper Time Secures Large Crop and Superior Fruit

GEO. C. HUSMANN

Pomologist in Charge of Viticultural Investigations, U. S. Department of Agriculture, Washington, D. C.

BECAUSE there is a bush fruit grown called currant, many people imagine that the dried grapes used so extensively in cakes, puddings, etc., are the dried fruit of the currant bush (Ribes species), when, in reality, the currants of commerce are dried grapes.

According to Eisen, they are referred to by Pliny as being grown in Greece in 75 A. D., after which there appears to be no further historical record of them for nearly a thousand years. During the eleventh century, in the old herbals and in the literature of the fourteenth, fifteenth, and sixteenth centuries, references to them occur as "reysyns de corauntzs," "Corauntz," "Corent," "rey sonys of Corawnce," "raysns of Coren," and "currans."

The name currant appears by gradual evolution to have developed from the name Corinth, the port from whence the early supplies of this fruit reached western Europe, furthermore the currant grapes were heard of 1,600 years before, and the name "currant" or "currantes" was applied to these grapes as early as 1578, several centuries before the common garden currant was first cultivated late in the sixteenth century.

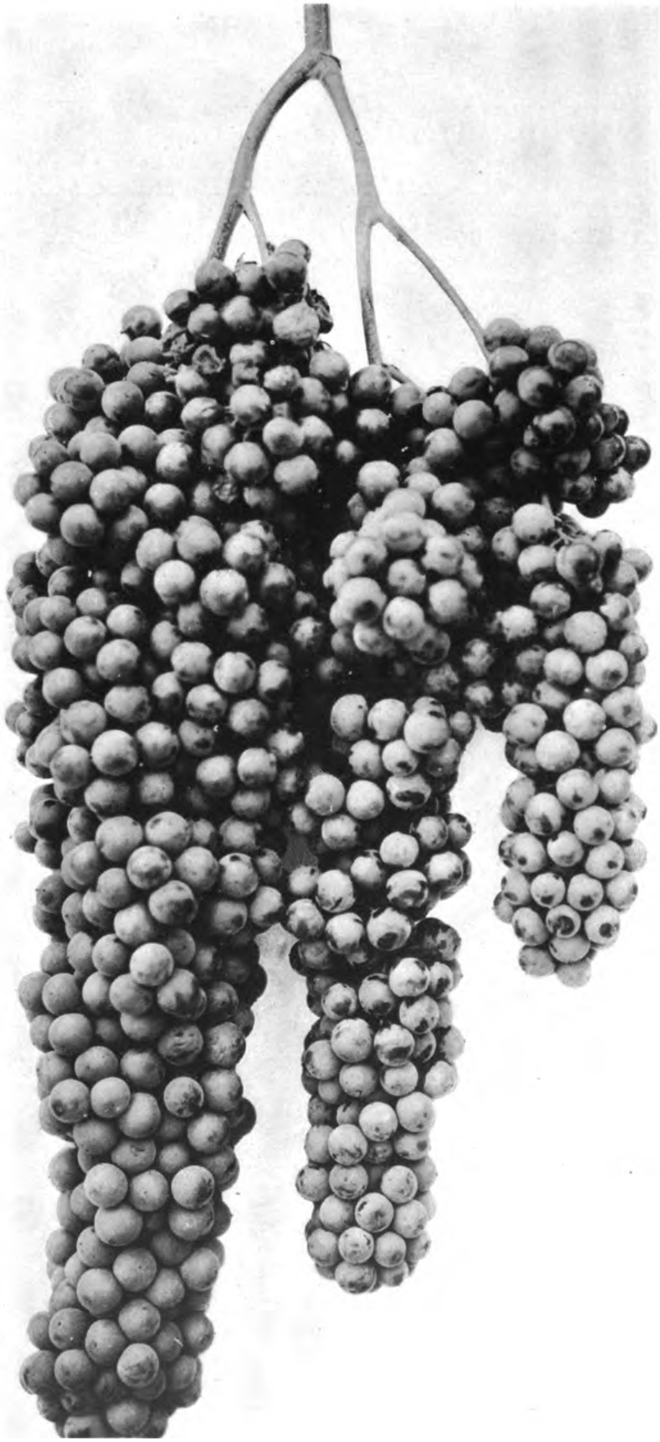
HISTORY OF THE CURRANT GRAPE

The following, relative to the importance of the currant grape industry in Greece, will prove interesting.

The destruction of the vineyards in France by phylloxera during the middle of the last quarter of the last century, caused a heavy demand at high prices for dried currants for use in the making of wine, brandy, etc. This resulted in the planting of so large an acreage of such grapes in Greece, that in some regions it became the sole industry.

The reestablishing of the French vineyards on phylloxera resistant grape stocks introduced from the United States, and France in 1896 and the imposing of import taxes on dried currants practically excluded them from France. This resulted in a serious crisis in the currant industry of Greece, the production of them being far in excess of the demand.

The "parakratesis" or "retention" act was passed by the Greek Parliament in 1895, for the purpose of maintaining prices and controlling the yearly output, and to prevent as far as possible, the overstocking of the markets. This law imposes on the producer a tax of 15% of the currants he exports, payable either in money or by deposits of the required quantity of currants in the government warehouses. The currants received by the government must be put to other than the usual uses made of them. This tax is one of the principal sources of revenue of the Grecian government. In connection with the passing of the retention act the establishing of the "currant bank" of Greece was agitated to enable producers depositing a certain quantity of currants in a government warehouse, either to draw money from



EFFECT OF GIRDLING ON THE CURRANT GRAPE CLUSTER

This cluster of the Panariti grape was borne by a vine of which the trunk had been girdled at blossoming time. The stock is Ruprestris St. George. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 5.)

CLUSTER FROM UNINCISED GRAPE VINE

Panariti cluster from unincised vine on Rupestris St. George. Fresno Experiment Vineyard. (Fig. 6.)

CURRANT GRAPE CLUSTERS FROM GIRDLED AND NOT GIRDLED VINES

On the left a saleable cluster of Panariti grape from a vine which was girdled at blossoming time. On the right three imperfect unfilled clusters from not girdled vines, showing their unsatisfactory character. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 7.)

such bank or to hypothecate their crop. Such a bank was finally established in 1899, with a capital of 300,000 drachmas (about $675,500), realized by the government from the sale of currants to distillers, etc. The United States, previous to the war, annually imported over 30,000,000 pounds of such dried currants the equivalent of 100,000,000 pounds or 50,000 tons of fresh grapes, as it takes about three pounds of fresh grapes to make one pound of dried.

CAN BE PROFITABLY GROWN

The United States Department of Agriculture has succeeded in demonstrating that these currant grapes can be profitably grown in America. This paves the way for the establishment of another very important and extensive grape industry in this country. Another exceedingly important matter is that the currant grapes are among the very earliest grapes to ripen, in fact, ripen so early that they will be dried and put away before the earliest rains occur in districts where other raisin varieties are too late in ripening, and in the present raisin sections of this country currants can be grown as an advance crop and be cured and stored by the time other raisin grapes ripen, so the same labor employed in harvesting and curing currant grapes can, after having accomplished that work, harvest and cure the other raisins.

Currant grape varieties were introduced into California as early as 1861, and these were followed by later introductions. Among all these, however, there appears to have been no valuable dark colored varieties, but some fairly productive red and white strains producing fruit of inferior quality.

The "Panariti" was introduced by the

GIRDLED CURRANT GRAPE VINE CARRYING FORTY-ONE POUNDS OF FRUIT

Photograph taken at ripening time of a Panariti currant grape vine grafted on the hybrid stock Aramon x Rupestris Ganzin No. 1. A ring of bark one-half inch wide was removed from the canes at blossoming time, two months previous to ripening time of the grapes. Compare with photograph of ungirdled vine carrying only twenty-one pounds of poorly formed clusters. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 8.)

United States Department of Agriculture through Mr. David Fairchild, Agricultural Explorer of the Department, a consignment of cuttings of them reaching Washington, D. C., May 9, 1901. Concerning this Mr. Fairchild stated at that time: "The variety of grape producing the currants or corinth of commerce. These cuttings were purchased in the village of Panariti, which lies among the mountains back of Xyloncastron. This village is noted as producing some of the finest corinths in Greece."

Several currant grape varieties are grown in Greece, though the crop differences are not distinguished in that country as varieties, but by the name of the region in which they are produced.

Some of the Panariti cuttings were distributed to grape growers in California, Arizona, and southern Nevada, and some used in experiments in the Department's Experiment Vineyards in California. Exceptional difficulties were encountered in successfully growing these, and it became a problem for the viticultural investigations of the United States Department of Agriculture to find out where the trouble was. The knotty parts of this problem appear now to have been solved.

Two cardinal points must be observed to grow them successfully, namely, they should be grown grafted on phylloxera resistant stocks congenial to them and suited to the soil and other conditions in which grown, and the vines need to be thoroughly girdled at the proper time.

In a ten-year test of growing them on various resistant stocks, a sufficient number of varieties of these stocks have been found from which to select such as are adapted to any of the soil types as well as to other conditions, and that are furthermore congenial to the currant grape varieties and on which they show good fruiting tendencies.

VINE GIRDLING NECESSARY

It has been ascertained that to make the blooms set and secure a full crop of fruit, the vines must be girdled. This girdling consists in making two parallel incisions through the bark, around either the trunks, arms, or canes of the vines, and taking out the bark between the two parallel cuts. This girdling must be thoroughly and cleanly done, and done while the vines are in bloom. Girdling the vines is not only necessary to promote a full setting and maturing of the fruit, but thereby more than twice as much and a better quality of fruit is obtained.

Vines in the United States Department of Agriculture Experiment Vineyards produced from eighteen to forty-five pounds of fruit to the vine, the crop depending largely on the variety of resistant stock on which the vines were grafted.

When vines are planted 8 x 8 feet apart (the usual distance) an acre will yield a crop of fresh grapes ranging from six to fifteen tons, an average of ten and one-half tons or conservatively from two to five tons of dried currants. From this we conclude that from 4,000 to 8,500 acres of these grapes would be necessary to produce the 30,000,000 pounds we annually import and consume, and, no doubt, the consumption of them could be much increased beyond this.

The berries being seedless, delicious in flavor, rich in quality, and so very early in ripening, they also make an exceedingly desirable fresh fruit for the table.

It is, of course, a great advantage in growing grapes for drying purposes, to be in a district which permits sun drying. All the districts in California, in which grapes for the various purposes are now grown, it appears have suitable conditions for the growing of currant grapes. Protection against the dew at night will likely be necessary in some of the coastal districts, but as it is preferable that the currants, while drying, be shaded during the great heat of the day, the same shelter will do for both purposes.

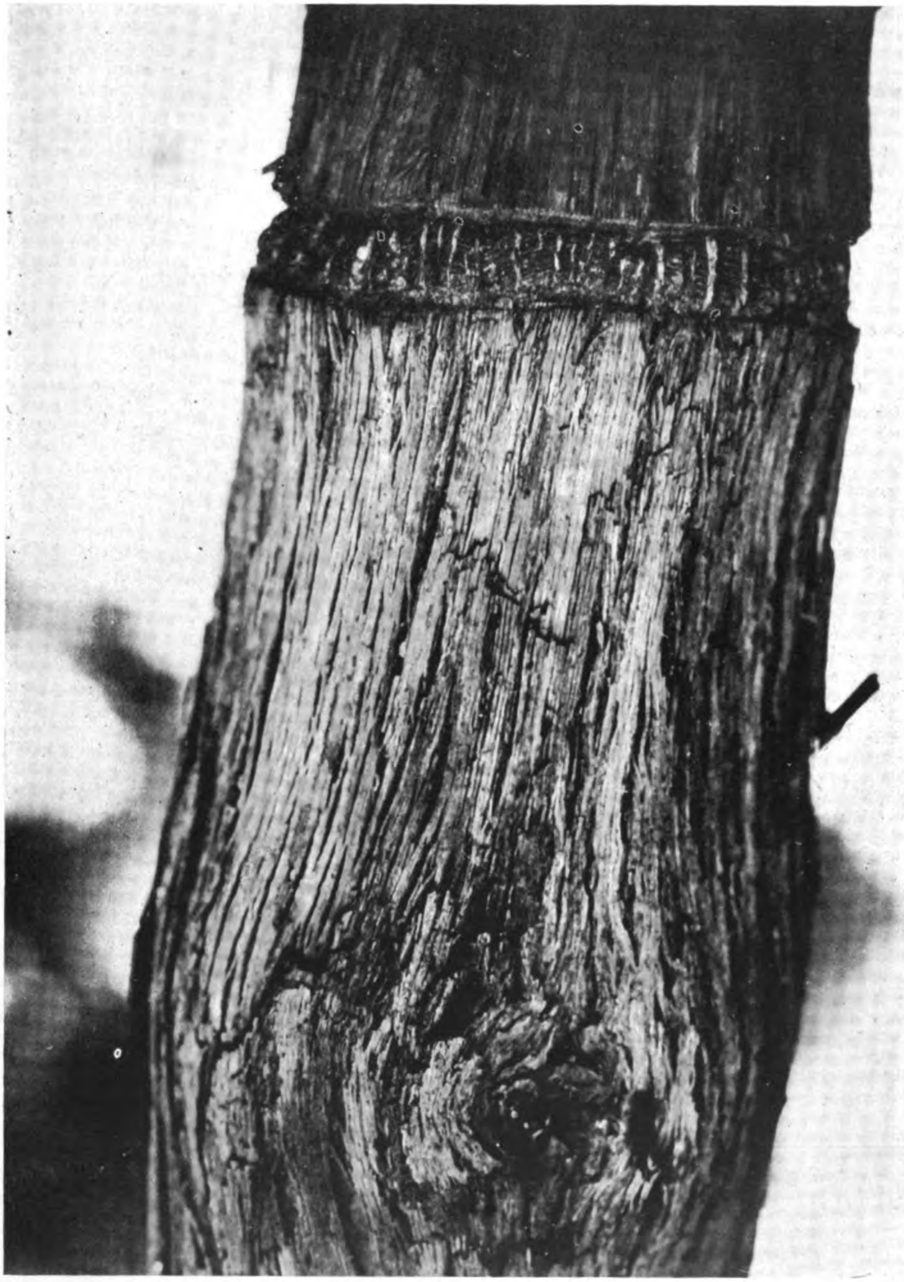
The importance of the Panariti in the currant group of grapes suggests a description of its fruit. Cluster fairly compact, cylindrical to tapering, long, narrow, usually prominently

NOT GIRDLED CURRANT GRAPE VINE CARRYING ONLY TWENTY-ONE POUNDS OF FRUIT

Photograph taken at ripening time of a Panariti currant grape vine grafted on the hybrid stock Aramon x Rupestris Ganzin No. 1 Not only do the not girdled vines of the Panariti grape bear much smaller crops of small inferior often imperfectly developed clusters, varying in compactness, but on many of them a majority of the berries never develope. This ungirdled vine carried only twenty-one pounds of poorly formed clusters. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 9.)

A GIRDLED CURRANT GRAPE VINE IN FRUIT

A ring of bark one-half inch wide was removed from the trunk at blossoming time two months previous to ripening time of the grape. A callus has formed, partly closing the incision which is still visible in the center of the photograph. The stock is Rupdstris St. George. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 10.)



THE GIRDLE SCAR ON A CURRANT GRAPE VINE

A ring of bark, one-quarter inch wide, was removed from this trunk of a Panariti vine. Photographed (enlarged three diameters) at ripening time, eight weeks after girdling was done. U. S. Department of Agriculture Experiment Vineyard, Fresno, California. (Fig. 11.)

shouldered, often in two parts. Berry very small, usually less than one-quarter inch in diameter, globose, color purple black with whitish bloom, surface smooth; skin thin, tender; flesh pearly white, soft, juicy, seedless. Flavor rich, very sweet and characteristic of the currant grapes. Relatively high in saccharine and acid. Excellent in quality both as fresh fruit and dried. Ripens from July 15 to August 15. Usually produces a small second crop of small loose clusters, of larger seeded berries.

Laboratory Methods Needed in Handling Defectives

Although the fact that mental defectives present a serious problem is now generally recognized, the statement by Dr. Wm. J. Hickson that a group of mental defectives representing feeblemindedness, psychopathy or both which aggregates but two per cent of our population keeps the other group of 98% busy caring for it, crystallizes the matter in a more serious light than many of the 98% realize. Social service work is receiving more and more approval and today prevention is recognized as a most vital part of the work. It is hence necessary that laboratory methods be used in psychiatry, and that vital questions be decided by expert medico-sociologists and not left to passions, prejudice, near knowledge or ignorance. Artificial laws will have to give way to natural laws in dealing with the defective as rapidly as the latter are discovered, and it is only by laboratory investigation replacing hit-or-miss guesswork that a solid scientific basis can be built up for future legislation.

Although environment has an unquestioned influence in molding the individual, there seems to be little doubt that it is extrinsic, while heredity is intrinsic. Daily experience teaches how numerous are those rising above their environment as compared with those sinking below it. After a psychopathologist has examined a case he can very closely approximate not only the family history, but also the past and future history of the case and what the progeny may be. In many cases where environment would seem to be the sole contributing cause to defection, it will be found that it is the inherently defective constitution of the 2% which has given way. It is an interesting fact that but 2% of those contracting syphilis develop parasyphilitic diseases such as tabes dorsalis and paresis. Laboratory methods and investigation may open ways of providing for those of inherently defective constitution, but heredity may well be called the hereditary enemy of medicine.

Effect of War on School Enrollment

Enrollment in American public schools has been affected by the war, but not to the extent of making it less than last year, according to figures compiled by the Department of the Interior through the Bureau of Education. Figures from 1,411 cities and 696 counties or districts show an increase of close to the normal amount of 2½% in elementary schools. In high schools, however, the increase is only one-fourth of the usual 9½%.

Such increase as there is in high school enrollment is caused by the girl students. Fewer boys are enrolled this year in every class in high school except the fourth; apparently there is a healthy tendency for boys in the senior year to remain and graduate.

In city elementary schools the increase in enrollment is actually somewhat above normal; but in city high schools there is a marked falling off, especially among the boys.

Country schools show some gains over last year both in elementary and high school enrollment, but not as great as would be expected under normal conditions. Rural high schools show increases for both boys and girls, despite the war.

PRODUCING BREAD MAKING WHEATS FOR WARM CLIMATES[1]

Introducing the Better Bread Making Quality of Soft Wheat Glutens into the Gluten of Macaroni Wheats—The Opaque Grain Indicates Insufficient Gluten, Translucent Grain an Abundance of It—Microscopic Sections an Aid in Breeding.

George F. Freeman

Department of Plant Breeding, University of Arizona, Agricultural Experiment Station, Tucson, Ariz.

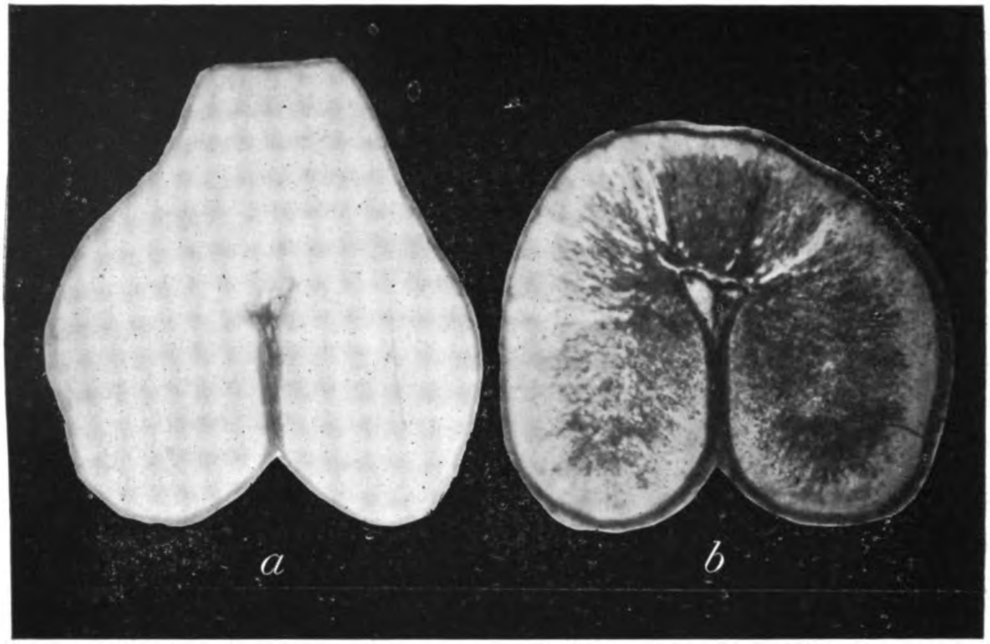
ECONOMIC wheat breeding always has for its aim the improvement of either the yield or the quality of grain or perhaps both. These objects are sought through many contributing sub-characters such as drought or disease resistance, stiffness of straw, time of maturity, texture of grain, size of berry, chemical composition, etc. As a character indicative of quality, the texture of the grain is usually considered important. A soft opaque texture is generally recognized as being associated with a low protein content whereas a horny translucent grain is characteristic of highly glutinous wheats. While quality, as well as quantity, of gluten ultimately determines the milling and baking value of a wheat, high gluten content is usually associated with the production of the best grades of flour. Whereas the writer has shown[1] that there are varieties of bread wheats which will maintain their hard horny texture in a warm irrigated district, the low yield of these strains when compared with the softer sorts, soon results in the elimination of the former group in any mixture where both are present, as is the case with practically all commercial planting. The result is that so nearly all of the wheat produced in warm, humid regions is soft in texture and of low gluten content that the public have come to believe that only soft wheat of inferior grade can be grown in such a region. Wheat breeders in such countries are, therefore, concerned with the production of varieties which are able to resist this softening tendency of the warm climate, and which are, at the same time, good yielders. It has also been shown (1. c.), that certain varieties of macaroni wheats remain hard when grown by irrigation in southern Arizona, and that, among these, those strains which maintained their hardness were the best yielders. Moreover, when these high yielding macaroni wheats were compared with the best producers among the soft bread wheats, they were found to be fully their equal. Macaroni wheats are not popular for bread making purposes on account of the fact that the loaf is not so large or light as that made from the bread wheats.

Now it was conceived some years ago that the bread-making quality of the high yielding soft wheats might be introduced into the gluten of the equally high yielding hard macaroni wheats, and result in the production of a high grade milling wheat for warm climates.

GOOD MILLING WHEAT FOR WARM CLIMATES

Accordingly, in 1913, reciprocal crosses were made between a white macaroni wheat (No. 1) coming originally from Algeria, a soft red bread wheat (No. 3) also imported from Algeria, and Sonora (No. 35), a soft white wheat commonly grown locally. The present paper gives the results of a study of the inheritance of grain texture through four generations of

[1] Freeman, Geo. F., 1917. A mechanical explanation of the progressive change of proportion of hard and soft wheat kernels. *Journ. Amer. Soc. Agron.*, Vol. x, No. 1 (1918), p. 23.



GREATLY ENLARGED CROSS SECTIONS OF MACARONI AND SOFT WHEATS

Cross sections of wheat grains photographed by transmitted light. (*a*) Pure macaroni. Endosperm texture flinty and translucent. Consequently photographing white. (*b*) Pure Sonora. Endosperm texture soft, rendered nearly opaque by many small diffusely scattered air spaces, which photograph dark. (Fig. 12.)

those crosses in which the macaroni wheat furnished one of the parents.

The difference between the texture of the hard, translucent grains of macaroni wheats and the opaque grains of soft wheats lies in the proportion of gluten to starch and the behavior of these compounds in the ripening of the grain. When sufficient gluten is present the entire cell contents, including the starch grains, remain cemented together, as the grain dries out in ripening, and the decrease in weight occasioned by the loss of water is accompanied by a corresponding shrinkage in the size of the grain. The solidly cemented mass therefore becomes translucent and glassy in texture as the grain approaches the air dry condition. On the other hand, when insufficient gluten is present, the starch grains are not held firmly together and when the grain dries out, instead of shrinking to fully compensate for the loss of water, air spaces appear. These air spaces serve as refracting surfaces and render the grain opaque.

In order to make a microscopical study of grain texture, it is necessary to obtain thin sections without disturbing the physical structure of the grain. The brittleness of hard wheats and the friability of those which are soft make it impracticable to cut thin sections with a razor from the dry grain. On the other hand, if the seed be soaked up with water or other softening solutions the physical structure of the endosperm is disturbed and does not return completely to its former condition when subsequently desiccated. Fortunately these difficulties may be overcome by making sections after the method used by petrologists in preparing thin sections of mineral or fossils for microscopical study. A section about 2 mm. thick is easily cut, or rather broken out, with a knife. By rubbing this section over the surface of a fine, flat file it may be quickly ground down to the thickness of ordinary writing paper. It is then transferred to the clean, dry surface of a yellow Belgian hone upon which it is further polished on both sides. This

polishing may be continued until the section has reached the desired thinness. In these operations the section is held between the ball of the finger and the grinding surface, light pressure being exerted as the section is moved to and fro. A thin, smooth cloth may be used to protect the finger from abrasion. By this means sections of only a few cells thickness and sufficiently transparent for microscopical study, may be prepared without, in any way, disturbing the physical structure of the endosperm. Such sections are best mounted for study directly in balsam, cedar oil, or concentrated glycerine. When viewed by transmitted light the horny solid parts of the endosperm are clear and transparent, and any air spaces present are made prominent as dark objects by the interception of the light. On the other hand, when viewed by reflected light, the air spaces appear as white masses on a dark background.

APPEARANCE OF GRAINS VARIES

The comparative appearance of typical sections of a hard and a soft wheat viewed with transmitted light is shown in Fig. 14. In this plate *a* is from a grain of Algerian macaroni wheat, and *b* is from the Sonora. It should be noted that air spaces are almost entirely absent from the endosperm of the macaroni wheat, and are very abundant and diffuse in the Sonora. The crossed seeds were very much wrinkled and exhibited an endosperm character intermediate between the parents. The seeds of the F_1 plants (F_2 endosperm) were also all wrinkled and more or less intermediate between the parents. There was, however, some variation in texture such as may be shown in the series given in Fig. 15. As is apparent from the plate, the members of this series grade insensibly into one another so that, whereas one may easily distinguish the extremes, the separation of the seeds into hard, intermediate and soft groups would be largely arbitrary. Nevertheless such a separation was attempted in the case of two F_1 plants, and the seeds planted to test the genetic significance of the separation. The results of this test, together with a summary showing the segregation of grain texture in all of the F_2 plants arising from the two macaroni bread wheat crosses here described, are shown in Table I.

TABLE I.—*Segregation of Grain Texture in the Seeds Borne on the F_1 and F_2 Plants of Macaroni Bread Wheat Crosses*

	Hard (*a*)	Intermediate (*b*) and soft (*c*)	
(1 x 35 cross F_1 plant No. 16–1)	23%	77%	
(1 x 35 cross F_1 plant No. 16–5)	14%	86%	
	F_2 plants with seeds		
	All hard (*a*)	Mixtures of hard (*a*) intermediate (*b*) and soft (*c*)	All soft (*c*)
Selected hard[1] seed from 16–1 gave as offspring	12	12	1
Selected soft [3] seed from 16–1 gave as offspring	.....	14	3
Selected hard[1] seed from 16–5 gave as offspring	7	7	1
Selected soft[3] seed from 16–5 gave as offspring	4	13	5
Unselected seed from 16–1 gave as offspring	11	36	17
Unselected seed from 16–5 gave as offspring	19	39	10
Total of 1 x 35 cross gave as offspring	682	1251	336
Percentage in each class	30%	55%	15%
Total of 1 x 3 cross gave as offspring	111	227	30
Percentage in each class	30%	61%	9%

[1] Seeds like Plate II, Fig. *a*. [2] Seeds like P'ate II, Fig. *b*. [3] Seeds like Plate II, Fig. *c*.

These results indicate clearly that the differences observed in the seeds borne on the F_1 plants were genetically significant, but that by mere inspection the separation of the different classes could not be made with complete accuracy. This was, in some measure, due to the wrinkled nature of the seed borne on the F_1 plants. Since many of the F_2 plants bore seeds which were plump, but which still exhibited the hard, intermediate or soft endosperm, separations could be made with much greater but still not complete precision. This is shown in the results of a continuation of the study of the offspring of the F_1 plant No. 16-5 into the third generation. An F_2 plant of the 1915 crop (No. 16-5-1-15) having seeds recorded as 28% hard (*a*) and 72% intermediate (*b*) or soft (*c*) was planted indiscriminately (as No. 263) and gave, in 1916, 49 plants of which 8 (16%) had all hard (*a*) seed; 32 (65%) had a mixture of hard (*a*) intermediate (*b*) and soft (*c*) seeds and 9 (19%) had all soft seed (*c*). Selected seed from the same mother plant gave the following results:

TABLE II.—*Inheritance of Endosperm Texture in Macaroni Bread Wheat Crosses*

	F_3 plants with seeds		
	All hard (*a*)	Mixtures of hard (*a*) intermediate (*b*) and soft (*c*)	All soft (*c*)
Selected hard (*a*) seed of No. 16–5–1–15 gave as offspring	39	8	
Selected soft (*c*) seed of No. 16–5–1–15 gave as offspring	....	27	17

(*a*) Like Plate III, Fig. *a*. (*b*) Like Plate III, Fig. *b*. (*c*) Like Plate III, Fig. *c*.

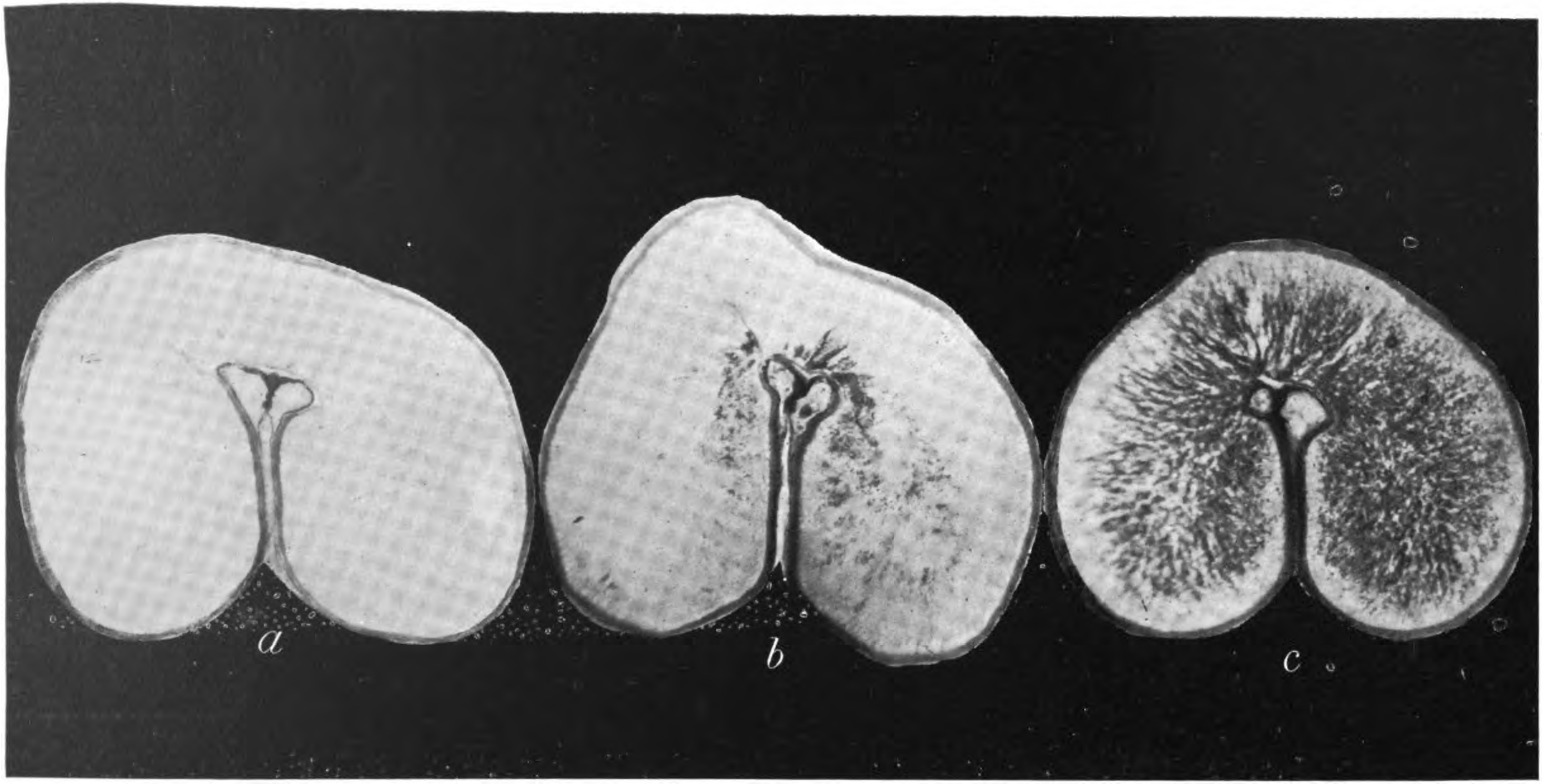
Six plants from the offspring of No. 263 were selected for a further study. The nature of the seeds borne on these selected plants and the character of their offspring are summarized in the following table:

TABLE III.—*Inheritance of Endosperm Texture in Macaroni Bread Wheat Crosses*

Selected mother plant No.	Character of seed of mother plant: Hard (*a*)	Intermediate (*b*) or soft (*c*)	Soft (*c*)	Kind of seed selected for planting	Character of offspring in 1917 — F_4 plants having seeds: All hard (*a*) No.	All hard (*a*) Per cent	Mixture of hard (*a*) intermediate (*b*) and soft (*c*) No.	Mixture Per cent	All soft (*c*) No.	All soft (*c*) Per cent
	Per cent	*Per cent*	*Per cent*		*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
263–7	....	....	100	Soft (*c*)	....	....	....	....	45	100
263–14	52	48	....	Hard (*a*)	22	49	23	51	....	....
				Soft (*c*)	....	....	9	20	36	80
263–23	100	....	....	Hard (*a*)	45	100	....	....	....	....
263–30	66	34	....	Hard (*a*)	28	61	18	39	....	....
				Soft (*c*)	....	....	18	45	22	55
263–48	100	....	....	Hard (*a*)	35	100	....	....	....	....
263–49	....	....	100	Soft (*c*)	....	....	....	....	47	100

ENLARGED CROSS SECTIONS OF FIRST GENERATION WHEAT HYBRID KERNELS

Cross sections of seeds from an F_1 plant of a macaroni-Sonora cross. Air spaces of the diffuse type. (*a*) When planted gave predominantly hard seeded plants. (*b*) When planted gave predominantly soft seeded plants. See Table I. (Fig. 13.)



ENLARGED CROSS SECTIONS OF SECOND GENERATION WHEAT HYBRID KERNELS

Cross sections of seed from an F_2 plant of a macaroni-Sonora cross, which was heterozygous for grain texture Opaqueness variable in amount, but all of the diffuse type. (*a*) when planted gave seeds predominantly hard; (*b*) when planted gave a mixture of all types; (*c*) when planted gave seeds predominantly soft. See Tables II and III. (Fig. 14.)

It will be noted from this table that whenever the parent plant had grains all soft or all hard, the parental character was followed in all of the offspring. When, however, the parental plant exhibited its hybrid nature by a mixture of grain types, the offspring varied according to the type of seed planted. Selected hard seed produced either plants having all hard seed or else plants having a mixture of hard and intermediate seeds, but no plants having soft seeds. Again, selected soft seed produced plants having a mixture of intermediate and soft seed or else plants with all soft seeds, but no plants having hard seeds. We may assume that seeds giving rise to plants having a mixture of grain types are heterozygous with regard to endosperm texture, whereas those giving rise to plants having seeds either all hard or all soft are homozygous with regard to these characters. The above results indicate therefore that we are unable, accurately to distinguish between hard and intermediate (homozygous and hybrid hard) grains, on the one hand, and between intermediate and soft (hybrid and homozygous soft, grains, on the other hand, but we mistake a homozygous hard grain for a homozygous soft one.

In the summer of 1915 a large number of plant selections were made from the F_2 plants of the macaroni bread wheat crosses from which plant rows were sown in the fall of the same year. A study of the inheritance of grain texture in the resulting F_3 generation harvested in the spring of 1916 can be summarized in the following table:

TABLE IV.—*Inheritance of Grain Texture in the F_3, 1916*

Character of seeds on the F_2 selected mother plants	Number of such mother plants selected	Character of seeds on F_3 offspring — No. plants having seeds: All hard (*a*)	Mixture of hard (*a*) intermediate (*b*) and soft (*c*)	All soft (*c*)
1 x 35 Cross				
All hard (*a*)	65	2,798		
Mixture of hard (*a*), intermediate (*b*) and soft (*c*) grains	23	694	114	
	7	145	107	
	25	154	668	163
	2	....	57	
	20	....	574	249
All soft (*c*)	59	....	755	1,715
	9	....	....	412
1 x 3 Cross				
All hard (*a*)	21	913		
Mixture of hard (*a*) intermediate (*b*) and soft (*c*) grains	2	50	27	
	33	33	253	77
	12	....	276	226
All soft (*c*)	6	....	68	108
	4	....	....	188

(*a*) Like Plate III *a*
(*b*) Like Plate III *b*.
(*c*) Like Plate III *c*.

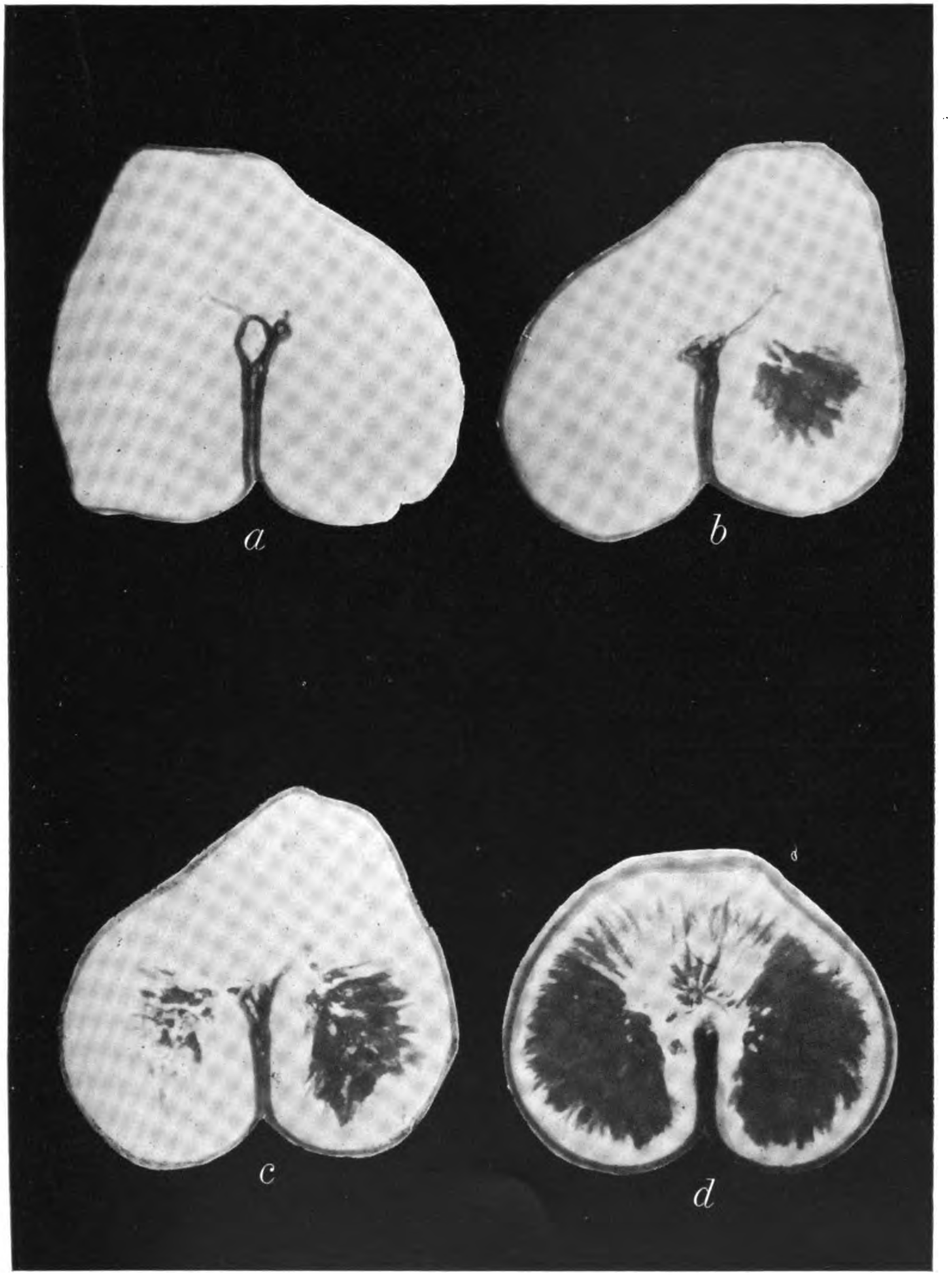
The results shown in Table IV coincide fully with those exhibited by Table III. It should be remarked that in all of the above tables the group headed "mixture of hard, intermediate, and soft," contains at least three types of plants, as follows: (1) Those bearing a mixture of hard and intermediate grains; (2) those with a mixture of hard, intermediate and soft grains, and (3) those with a mixture of intermediate and soft grains. These types so insensibly grade into one another that it was found impracticable to separate them. It may, however, be stated that where the offspring of a given mother plant segregate only into plants with all hard seed, and those with a mixture of types and none with all soft seed, the seeds on those plants with mixed types tend toward the harder limits of the series, *i. e.*, they fall into type (1) of the series described above. When the offspring of a single mother plant segregate into plants having all hard seeds, plants with a mixture of types and plants having all soft seeds, then many of the plants having seeds of mixed types show every gradation of seed type from hard through intermediate to soft. Again, when the offspring of a single mother plant segregate into plants having a mixture of seed types and plants with all soft seeds, the seeds on the plants having a mixture of types tend strongly to fall into the softer end of the series, *i. e.*, to consist of a mixture of intermediate and soft seeds. The character of the seed on mother plants having a mixture of seed types gives a strong indication of the kind of segregation to be expected in the offspring. If they fall within the harder end of the series they tend to give only plants with all hard seeds, and plants with a mixture of hard and intermediate seeds. If they lie nearer the softer end of the series, then the offspring tend to segregate only into plants having a mixture of intermediate and soft seed and plants with all soft seeds. Finally, if the mother plant contains all types of seed, then all types of plants may be expected among the offspring. The continuous intergradation of seed types would render any numerical separation purely arbitrary. A judgment of the genetic composition of the parent by the behavior of its offspring is, therefore, here, as in many other cases, the only sure means of analysis.

TWO FACTORS APPEAR PRESENT

A genetic analysis of the data presented can be made by assuming that the relative proportion of gluten and starch in the endosperm of the wheat varieties studied is controlled by two factors, the intensity of the action of which may be varied within somewhat narrow limits by environic conditions in the same manner that the intensity of action of other factors governing quantitative characters are varied by their environment. The combination of these variations, partly genetic and partly environic, are, therefore, amply sufficient to account for the intergradation of grain types and the impossibility of making exact numerical separations.

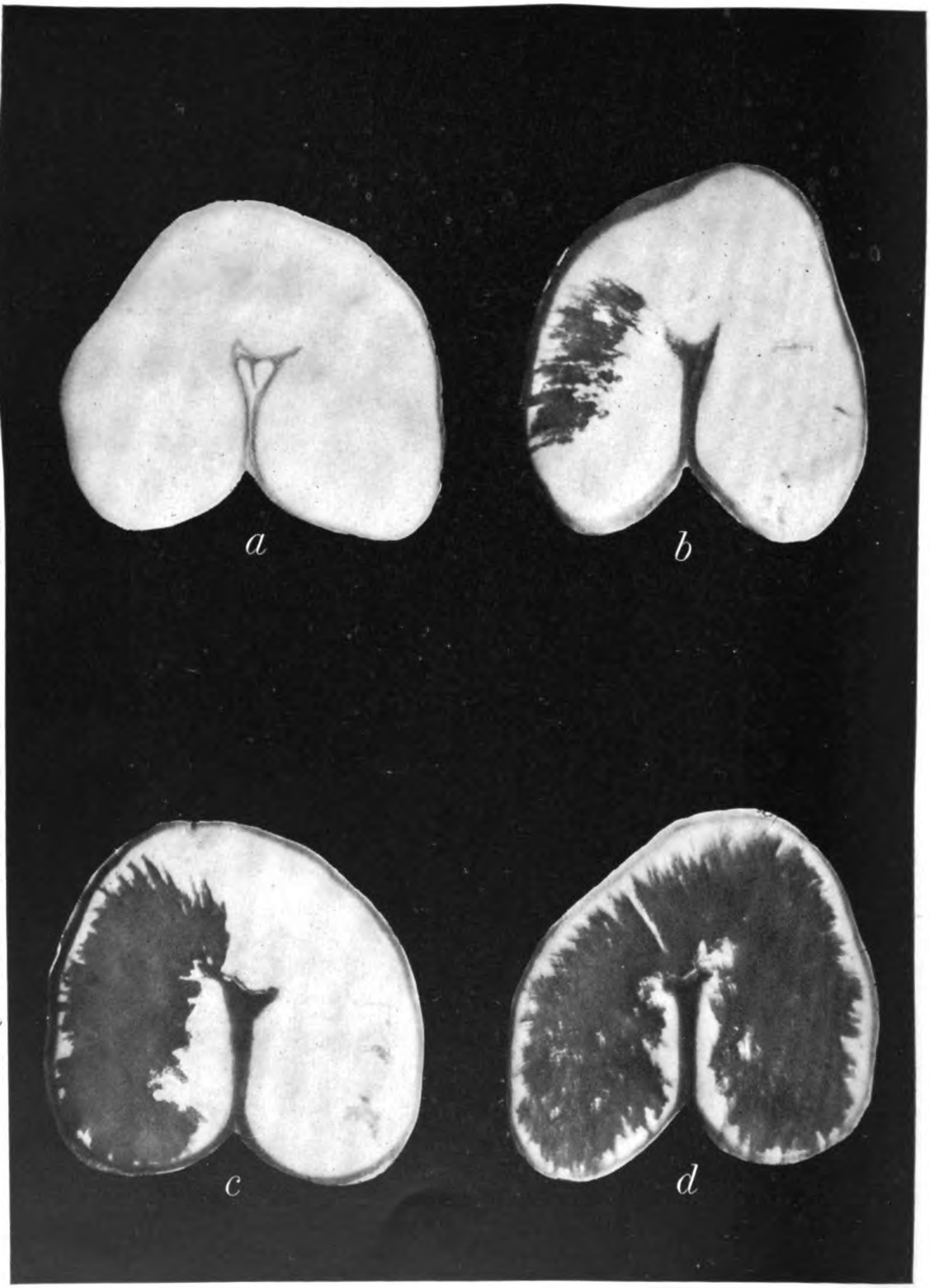
With these ideas in view, let us now assume two factors for increasing the percentage of tarch A and B having incomplete dominance over their absence and being accumulative in their action. Let us suppose further that (by the standards of comparison used by the writer) the presence of three A's together with at least one B in the endosperm cells (assuming double fertilization) of a grain were sufficient to cause it to be classed as soft, whereas less than three A's and B's counted together would result in an endosperm which would be graded as "hard." All other seeds would be graded as "intermediate."

The genetic composition of the F_2 embryos, and, hence, of the somatic tissue of the F_2 plants arising therefrom, together with the genetic structure of the endosperm of the seeds and embryos borne on these plants, can be placed in tabular form as follows:



MACARONI WHEAT KERNEL CROSS SECTIONS SHOWING YELLOW BERRY SPOTS

Cross sections of the seed of a pure macaroni wheat plant, showing a clear hard grain (*a*) and varying sizes of yellow-berry spots (*b*, *c*, *d*). The air spaces causing these opaque spots, lie in plates with quite definite margins. The proportion of gluten to starch is roughly indicated by the light and dark areas. (Fig. 15.)



HYBRID WHEAT KERNEL CROSS SECTIONS SHOWING YELLOW BERRY SPOTS

Cross sections, greatly enlarged, of the seed from an F_2 plant of a macaroni-Sonora cross which was homozygous for hard grains but which showed a small percentage of grains with yellow-berry spots. When planted, all of these types gave practically the same results. The dark areas are proportionately richer in starch than the light ones. See Table IX. (Fig. 16.)

Table V.—*Factorial Analysis of the Heredity of Grain Texture*

					Comparison of theoretical with found results in F_2		Comparison of theoretical with found results in the F_3		
Genetic formulae of F_2	Genetic formulae of F_3 embryos	Genetic formulae of F_3 endosperm borne on F_2 plants	Grade of individual seed	Grade of seed of plant as a whole recorded in table	Percentage of plant expected in this group	Percentage of total No. of plants found in this group. (Summary of both crosses in Table I)	Type of grain	Percentage of total No. of plants expected of each type	Percentage of F_3 plants found in each type. (Summary of both F_3 crosses in Table IV)
ABAB	ABAB	ABABAB	Soft				Soft	100	100
ABAb	ABAB	ABABAB	Soft		19	14	Soft		
	ABAb	ABABAb	Soft	Soft			Inter-	75	69
	AbAB	AbAbAB	Soft				mediate	25	31
AbAB	AbAb	AbAbAb	Intermediate						
ABaB	ABAB	ABABAB	Soft				Soft	25	35
	ABaB	ABABaB	Intermediate				Intermediate	75	65
	aBAB	aBaBAB	Intermediate						
aBAB	aBaB	aBaBaB	Intermediate						
	ABAB	ABABAB	Soft						
ABab	ABAb	ABABAb	Soft						
	AbAB	AbAbAB	Soft						
	AbAb	AbAbAb	Intermediate						
	ABaB	ABABaB	Intermediate				Soft	19	18
abAB	aBAB	aBaBAB	Intermediate				Intermediate or mixed	50	68
	ABab	ABABab	Intermediate	Intermediate or mixed	50	56	Hard	31	14
	abAB	ababAB	Hard						
	AbaB	AbAbaB	Intermediate						
AbaB	aBAb	aBaBAb	Intermediate						
	Abab	AbAbab	Hard						
	abAb	ababAb	Hard						
	aBaB	aBaBaB	Intermediate						
aBAb	aBab	aBaBab	Hard						
	abaB	ababaB	Hard						
	abab	ababab	Hard						
AbAb	AbAb	AbAbAb	Intermediate						
aBaB	aBaB	aBaBaB	Intermediate				Intermediate	100	100
	AbAb	AbAbAb	Intermediate						
Abab	Abab	AbAbab	Hard						
	abAb	ababAb	Hard						
abAb	abab	ababab	Hard				Intermediate	25	22
	aBaB	aBaBaB	Intermediate				Hard	75	78
aBab	aBab	aBaBab	Hard	Hard	31	30			
	abaB	ababaB	Hard						
abaB	abab	ababab	Hard						
abab	abab	ababab	Hard				Hard	100%	100%

In view of the almost perfect intergradation of types as already explained and, hence, the difficulty of making exact numerical separations, the data actually found and the theoretical expectations show a rather remarkable closeness of fit. Especially noteworthy is the fact that all of the theoretically expected groups are present, and in no case behave in a manner contradictory to the assumed factorial explanation.

Many students of grain texture in wheat have been confused and misled by the occurrence of so-called "yellow berry" in hard wheats. Many wheats which in a northern or dry climate produce hard, translucent grains, in a more humid or southern climate will produce a greater or less proportion of grains containing opaque spots in the endosperm. Grains containing such spots are commonly called "yellow berries." When the opaque spot is extended to include all or nearly all of the endosperm, the whole grain appears to be opaque and may be easily mistaken for an ordinary soft wheat. The difference, however, is, in most cases, easily determined by a microscopic examination of thin sections prepared as described above. Fig. 16 gives several types showing the intergrading series from a true hard to a true soft wheat, indicating that grain texture is a quantitative character depending, in all probability, upon the relative proportions of starch and gluten in the endosperm as previously explained. These were all from the seeds of a single hybrid wheat plant which was heterozygous for grain texture. Fig. 17 gives a paralllel series from a single plant of a pure race of a hard wheat (Algerian macaroni), and exhibits several types extending from a grain which was translucent throughout, to those with larger and larger "yellow berry" spots until the endosperm of the seed at the right is practically all included in the yellow spot. Fig. 18 gives a similar series taken from an F_2 macaroni Sonora hybrid plant which was homozygous for hard grain texture. Comparing Fig. 16 with Figs. 17 and 18 one readily sees that the air spaces causing the opaqueness of the "Yellow Berry Spot" lie in flakes, whereas those of the true soft wheat are diffuse.

HEREDITY OF "YELLOW BERRY"

The heredity of the diffuse or true softness has been shown and discussed above. We may now investigate the nature and heredity of "Yellow berry." The following table gives a number of selected cases showing the variation in the percentage of yellow berry in pure lines of hard wheats in different years and when grown under different environic conditions in the same year:

TABLE VI.—*Environic Variations in Percentage of "Yellow Berry" Grains in Pure Lines of Hard Wheat*

Pedigree No.	Environic condition	Percentage of yellow berries in crop of		
		1914	1915	1916
36–19	Nursery row Yuma	35	10	0
36–20	Nursery row Yuma	97	54	7
36–21	Nursery row Yuma	31	43	0
36–43	Nursery row Yuma	36	50	2
36–43	Increase plot Yuma	....	95	35
36–51	Nursery row Yuma	15	28	0
36–51	Increase plot Yuma	....	96	42
36–81	Nursery row Yuma	11	33	4
36–81	Increase plot Yuma	....	85	35
3–12	Nursery row Yuma	0	96	12

Where the percentage of yellow berries was large, the opaque spots were large and frequently included the entire endosperm. On the other hand, where the percentage of yellow berries was small, the opaque spots were small

and there was but few cases where they included more than half the endosperm.

An F_2 plant (No. 16-1-2-13) of the 1915 crop, having hard seeds (20% translucent throughout, 80% with opaque spots, *i. e.*, "yellow berries") was chosen, and 50 unselected seeds planted as No. 239. In the spring of 1916, these gave 34 plants all having seeds classed as hard, but among which there were an average of 23% of "yellow berries." The distribution of the percentages of yellow berry among these plants may be given as follows:

TABLE VII

Per cent yellow berry	0	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100
No. plants	8	8	6	3	2	1	1	2	1	1	1

Going back to the original plant (No. 16-1-2-13), 25 translucent and 50 yellow berry seeds were selected and planted in adjoining nursery rows with the following results:

TABLE VIII

Per cent yellow berry	0	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	81–90	91–100	Total No. plants	Average per cent yellow berry
Plants from translucent seeds	14	....	1	....	....	1	....	....	1	....	....	17	8
Plants from yellow berry seeds	18	9	1	3	2	3	....	....	1	....	1	38	12

In the fall of 1916 seeds from five plant selections from No. 239 were planted. The nature of the seed planted and the crop obtained are summarized in the following table:

TABLE IX.—*Heredity of Yellow Berry*

Parental No.	Per cent yellow berry in mother plant	Pedigree No.	Kind of seed selected	Distribution of percentages of yellow berry in plants of offspring: 0	1–10	11–20	21–30	31–40	Total No. plants	Average per cent of yellow berry
239–7	87	1006	(*c.*, *d.*) Yellow berry	18	15	4	1	1	39	4
239–7	87	1005	(*a*) Translucent	19	4	1	....	....	24	1
239–18	57	1010	(*c.*, *d.*) Yellow berry	15	12	3	1	2	33	5
239–18	57	1009	(*a*) Translucent	24	17	....	1	1	43	2
239–33	29	1012	(*c.*, *d.*) Yellow berry	31	12	....	1	....	44	1
239–33	29	1011	(*a*) Translucent	31	11	1	1	....	44	2
239–10	100	1007	(*c.*, *d.*) Yellow berry	20	14	5	3	1	43	5
239–19	0	1008	(*a*) Translucent	33	2	....	....	....	35	0

(*a*) Like Fig. 18 (a). (*c*) Like Fig. 18 (c). (*b*) Like Fig. 18 (b). (*d*) Like Fig. 18 (d).

While one may see in this table a slight tendency of the yellow berry seed to produce a higher percentage of yellow berry in the offspring, the differences are so slight and the regression so strong that one may easily question its significance. A comparison of Tables III and IX is sufficient to convince one immediately that the heredity of yellow berry is at least something wholly different from that of true hardness and softness as exhibited in Table III. The study of the diffuse type of opaqueness (softness) has clearly shown that this character (though quantitative and, hence, difficult of exact separation into genetic classes) is strictly hereditary. It may, moreover, be pointed out that pure lines of true soft wheats (diffuse type) such as Sonora, Algerian Red Bread, and Early Baart are 100% opaque[2] every year, and never exhibit environic variations in hardness such as is shown by pure lines of hard wheats, examples of which are given in Table VI.

DEPENDENCE ON ENVIRONMENT

The great dependence of yellow berry on environic conditions and its almost complete regression from the selection of extreme variants, suggest strongly that this is quite largely a physiological response. True, a tendency toward greater or less sensitivity of this response may be inherited and it may be possible that those grains in a head carrying genetic factors for greater sensitivity would be the first to respond to environic conditions tending to favor the yellow berry character whereas those same grains under conditions favoring greater hardness would have remained perfectly translucent throughout. This would account for the slight but quite uniform differences exhibited in tables VIII and IX. Convincing proof that the tendency toward the production of yellow berry in hard wheats is hereditary is shown in an experiment with 145 pure races of turkey wheat extending through the years 1914, 1915 and 1916. Here the correlation of the percentage of yellow berry in 1914 with the same in 1915 was $+57\% \pm 4\%$, whereas that between 1915 and 1916 was $+33\% \pm 5\%$, and between 1914 and 1916 was $+41\% \pm 5\%$. These correlations being more than six times their probable errors are certainly significant.

Among the F_2 plants originating from the Macaroni-Sonora cross, there were 65 which had grains recorded as all hard (or with a greater or less percentage of yellow berry), and which gave all hard or "yellow berry" offspring, *i. e.*, produced no plants having any intermediate or soft grains (diffuse type).[3] Many of these, however, contained a greater or less percentage of "yellow berries." The correlation calculated between the percentage of yellow berries in these parents and the average percentage of yellow berries in their offspring was $+51\% \pm 6\%$.

REGRESSION IN PARENTAL STRAINS

The strong regression from extreme selections, but still quite definite inheritance of the tendency to produce yellow berry, is perhaps better shown by arranging the parental strains or mother plants in accordance with the percentage of yellow berry they contain and then showing the distribution and average of their respective offspring as is done in the Table X.

The arrangement here shown was made so as to divide the parental strains or plants, as nearly as possible, into three equal groups. While the differences between the groups are not large, the numbers involved and the uniformity of results certainly render them significant.

CONCLUSIONS

1. The hardness of a wheat is determined by the solidity of the grain, and this, in turn, by the nature and relative proportions of gluten and starch in the endosperm.

2. When the ratio of gluten to starch

[2] Like Plate I, Fig. *b*.
[3] Like Plate III, Figs. *b* and *c*.

TABLE X.—*Inheritance of Percentage of Yellow Berry in Hard Wheats*

Percentage of yellow berry in parents	Average percentages of yellow berry in offspring																			No. of races	Average percentage of yellow berry
	0	1–4	5–8	9–12	13–16	17–20	21–24	25–28	29–32	33–36	37–40	41–44	45–48	49–52	53–56	57–60	61–64	65–68	69–72		
145 pure races of Turkey wheat; crop of 1914 compared with that of 1915																					
0–24	1	8	8	6	7	1	4	3	2	3	3	1	4	1			1			53	20
25–49	1	3	5	2	3	4	4	3	1	2	3	5	2	3		2	2	1		46	29
50–100			1	1	2	2	5	6	5	4	7	5	1		4		2		1	46	34
145 pure races of Turkey wheat; crop of 1914 compared with that of 1916																					
0–24	38	11	3	1																53	1
25–49	26	13	1	4			1		1											46	3
50–100	19	15	6	4				1		1										46	4
145 pure races of Turkey wheat; crop of 1915 compared with that of 1916																					
0–19	36	14	1	3																54	1
20–39	27	15	4	4																50	2
40–100	20	10	5	1		1	1		1	1										40	5
65 homozygous hard wheats of hybrid origin (Macaroni-Sonora)																					
0	9	14	3	2	1			1												30	4
1–13	5	4	4		2															15	5
14–91		4	5	4	3		2	2												20	11

is sufficiently high, the entire cell contents are cemented together solidly as the grain dries out in ripening. It, therefore, takes on a hard, glassy, semi-translucent texture. In the absence of a sufficient proportion of gluten to hold the cell contents together, the shrinkage in drying does not fully compensate for the loss of water, and air spaces appear within the cells. These open spaces render the grain soft and, also, since they serve as refracting surfaces, make it opaque. We are, therefore, accustomed to associate softness, opaqueness and low gluten content in wheats.

3. There are two types of soft grains among the wheats included in these experiments.

(*a*) A type designated by the writer as "true softness" in which the air spaces in the endosperm are diffuse and finely scattered. This type of softness is only slightly affected by environic conditions.

(*b*) A type commonly called "yellow berry" in which the air spaces within the endosperm occur in flake-like groups with quite definite margins. The opaqueness thus arising may be confined to a small spot only or may include the entire endosperm. This type of softness is very sensitive to environic conditions.

4. The genetic behavior of "true softness" in the wheats crossed by the writer may be explained by two independent factors governing the relative proportion of gluten and starch. These factors show incomplete dominance over their absence, and appear to be accumulative in their action, *i. e.*, the intensity of their action depends upon the number of times the factors appear in the endosperm. Thus (assuming double fertilization) the presence of none to six factors in the endosperm cells gives rise to a series of types grading from hard (translucent) through almost insensible degrees to completely soft (opaque) grains.

5. The genetic factors governing the appearance of "yellow berry" have not been fully analyzed, but they are evidently distinct from those which give rise to "true softness." These factors are very sensitive to environic influences, and changes in climatic, soil, and cultural conditions so vary the intensity of their action as almost to cause one to overlook their hereditary nature. However, in spite of the strong regression from extreme selections, the almost perfect uniformity of results from a number of carefully controlled experiments indicate that genetic factors, for a greater or less sensitivity, are inherited as definitely as are other factors governing quantitative characters. The number of factors involved have not been determined.

Selection of Laying Hens

Since it is always of prime importance to keep only the best layers in any flock of hens, many tests have been devised for selecting good layers. Some of these, such as the trap-nest, have been technically satisfactory, but have proven too difficult of operation for the average breeder, while many others have been found to contain a minimum of substance as well as a maximum of superstition.

It has been observed that paling of the leg color is often correlated with heavy laying, which is only natural, since a three pound bird, may store away more than her own weight of fatty and nitrogenous substances in the 150 eggs she lays. It has been found[1] that by measuring the amount of yellow pigment in the body fat, the hens may be graded according to their egg records.

The findings of the bulletin may be summarized as follows:

The laying activity causes loss of yellow pigment in the body fat of various breeds of the domestic fowl. A cessation of laying causes a return of the yellow pigment.

The ear lobes, vent and beak are the parts most quickly responsive to a change in laying activity, while the legs are the last to respond. By taking measurements of pigmentation in October, the average past egg record can be estimated. The ear lobes are most readily graded by means of the color top.

When thus graded, the per cent yellow in the ear lobes in October shows a relatively close relationship with annual egg production. (This relationship, expressed mathematically in terms of the correlation coefficient, is between —.5 and —.6.) This relationship is an indirect one, being dependent upon the correlation existing between the laying activity of the period preceding the pigment measurements and the annual egg production.

The changes in body pigment may be used to advantage in separating the high from the low producers. The selection for breeders can best be done in October, when only the high producers are laying.

Other characters besides paling of yellow pigment, viz.: bright color and full size of comb and late molting, may indicate good laying ability. The "Standard of Perfection" in demanding yellow beaks and yellow legs penalizes production. Changes should be made in the score cards in order to insure in poultry shows better as well as more beautiful birds.

[1] Pigmentation and Other Criteria for the Selection of Laying Hens. Albert F. Blakeslee and J. Arthur Harris, station for Experimental Evolution, Cold Spring Harbor, L. I.; D. E. Warner, Connecticut Agricultural College; Wm. F. Kirkpatrick, Storrs Agricultural Station. Storrs Agricultural Experiment Station, Storrs, Conn. Bulletin 92, December, 1917.

COLOR INHERITANCE IN MAMMALS

XI, Man—Mode of Inheritance of Unusual Family Traits Easy to Analyze. Situation More Obscure in Case of Common Variations. Variations in Hair, Skin, and Eye Color Must be Considered Together. At Least Two Distinct Kinds of Dilution of Color Probably Exist, Which Are Combined in the Blond Nordic Race

$1a_1$	W, w	W—Premature grayness of certain families.
$1a_2$	V, v	V—white spotting.
$1a_3$	——	
1b	C, c	c—albinism in many cases. Variations of this class, common in white race, reduce dark eyes to light, red hair to flaxen, but have little effect on black hair. Reduction of skin color.
$2a_1$	——	
$2a_2$	——	
$2a_3$		Variations of this class, common in white race, reduce dark eyes to light or even albinotic, black hair to red, yellow, flaxen, or white, depending on factors of class 1b. Auburn and brown intermediate variations. Reduction of skin color.
2b	——	

AMONG human beings, the common variations in hair, skin, and eye color resemble many of those of the lower mammals. In spite of this similarity, however, the mode of inheritance is, in most cases, still very obscure. It is only in the case of certain rare variations which are obviously associated with particular families that unit factors can be said to be conclusively demonstrated.

PREMATURE GRAYNESS

A typical example of such a variation is present in a pedigree (MM) given by Pearson, Nettleship, and Usher.[1] Among the affected persons of this family, the hair became gray in youth. In each case, one parent was prematurely gray, while the normal children showed no tendency to transmit the trait. In the published pedigree, the trait has been handed on for at least five generations without a break. Probably it went much farther back as the authors give a translation of an old Gaelic curse said to have been pronounced in the fourteenth century.

"In the time of most numbers shall weakness come o'er them,
In the time of most weakness, shall strength then restore them,
In their prime in their youth like the rushes they'll grow,
As withers the bracken be their manhood laid low,
O'er the child's clustering ringlets shall age spread its snow."

We have here clearly a dominant hereditary unit which is passed on indefinitely without attrition in spite of union with fresh normal stock in each generation. As regards its relationship to color factors in the lower mammals, it seems closest to those which have been put in class $1a_1$. There is a general inhibition of hair pigment regardless of quality. The dominant factor for grayness in horses has the further similarity in that the whiteness increases with age.

Holmes and Schofield[2] have recently published a pedigree in which a small white lock was present only in males, but could be transmitted by the mother. The inheritance was not sex-linked, as affected males could transmit it to their sons. The authors attribute it to sex-limited inheritance. According to this view, the trait is inherited as a dominant unit by the usual mechanism, but

[1] Pearson, K., E. Nettleship, and C. H. Usher, 1913, "A Monograph on Albinism in Man." Dulau and Co., London.
[2] Holmes, S. J., and R. O. Schofield, JOUR. HER., 1917, 8:359-362.

is either unable to manifest itself at all in females or else does so only when homozygous as in the case of horns in sheep or the mahogany color in Ayrshire cattle.

The spot is not present in childhood, but develops at puberty. The authors think it probable that hormones developing at that time may be essential. They note that in one of the pedigrees given by Pearson, Nettleship, and Usher, a small occipital spot was inherited in a similar manner.

WHITE SPOTTING

Another peculiar color character, the heredity of which is easily traced, is the piebald or white spotted condition. In piebald individuals the skin is wholly devoid of pigment in irregular areas especially on the ventral surface of the body, on the face and on the head. There is much variation in the amount of white spotting. In some families there is only a white flare in hair above the forehead or a small, white spot on the head. Such a variation is naturally most conspicuous in the colored races, and spotted negroes have often been exhibited at shows. Simpson[3] and Castle studied such a case, and found the piebald condition to be inherited for at least three generations without a break. The trait clearly followed the mechanism of a unit dominant factor. Pearson, Nettleship and Usher[4] have collected together a number of pedigrees involving piebalds. Some of these extend for six generations, but in all cases, with the exception of the sex-limited spot already noted, the trait is transmitted as a dominant unit.

An interesting family history in which a white flare has been transmitted for at least six generations, and probably more, was published by Miller.[5] Here, as in the case of premature grayness cited above, we find the old family tradition, so commonly found where a peculiar trait behaves as a dominant unit. In this case the white spot is said to have originated in a posthumous son of Harry "Hotspur" Percy, born in 1403. Its appearance was attributed to an action of Lady Percy in pressing her hands to her forehead when she swooned on hearing of her husband's death at the battle of Shrewsbury.

Piebald has been spoken of as dominant, but we do not know what a homozygous piebald would be like. As Castle and Simpson pointed out, such an individual might be so nearly unpigmented that the trait would be more nearly recessive than dominant. Such an individual could only come from the union of piebald with piebald. Again, piebald has been spoken of as a unit. This is certainly true in each particular family, but it is not certain that it is the same unit in each case. We might get two factor ratios after a union of piebald with piebald.

ALBINISM

Albinism is a third peculiar color trait the mode of inheritance of which is usually easy to understand. Pearson, Nettleship, and Usher[6] have collected together an enormous amount of information in regard to albinos, including over 600 pedigrees. The trait is found sporadically among all races of the world. There is much variation in the degree. In the most extreme cases there is exceedingly little, if any, pigment in skin, hair, and eyes. The hair is white, the skin white and very easily burned by the sun, and the eyes have a pale gray iris and a red reflection through the pupil in the proper light. There is photophobia, imperfect vision, and nystagmus, all doubtless due to the defective pigmentation of the retina.

Among Europeans, however, no sharp line can be drawn between albinism and extreme blondness. Here the photophobia, imperfect vision, and nystagmus are usually considered the criteria. These may be combined with light brown, pale yellow, or, occasionally, even light red hair, as well as with

[3]Simpson, Q. I., and W. E. Castle, *Amer. Nat.*, 1913, 47:50-56.
[4]Pearson, Nettleship, and Usher, *loc. cit.*
[5]Miller, Newton, Jour. Her., 1915, 6:165-169.
[6]Pearson, Nettleship, and Usher, *loc. cit.*

the usual white color. The iris is usually pale blue rather than colorless. The skin may show some pigmentation, especially as freckles. In the colored races such freckles are the rule. Even in these races, the gap between normals and albinos is bridged by various dilute types. There are all grades of imperfect albinos which may or may not show visual difficulties.

It is evident that no one unit factor can explain all the phenomena of albinism. Nevertheless, the usual mode of inheritance within families is clear. We do not find long unbroken lines of descent as in premature grayness and white spotting. In a typical pedigree, albinism will be found, perhaps, in several children of a family. The parents may both be normal, but the trait will be found cropping out in several more or less distant cousins. One of the very striking features of pedigrees, as Pearson points out, is the great frequency of cousin marriages among the parents of albinos. Castle[7] and Farabee, as early as 1903, pointed out the probability that albinism behaved as a recessive unit, and Davenport[8] demonstrated it in a considerable number of pedigrees, including three cases in which albino by albino had had only albino children (four in all). Apert[9] analyzed the data of Pearson, Nettleship, and Usher and pointed out that the ratios of albino to normals, correctly interpreted, was close to that expected on the hypothesis of a recessive unit.

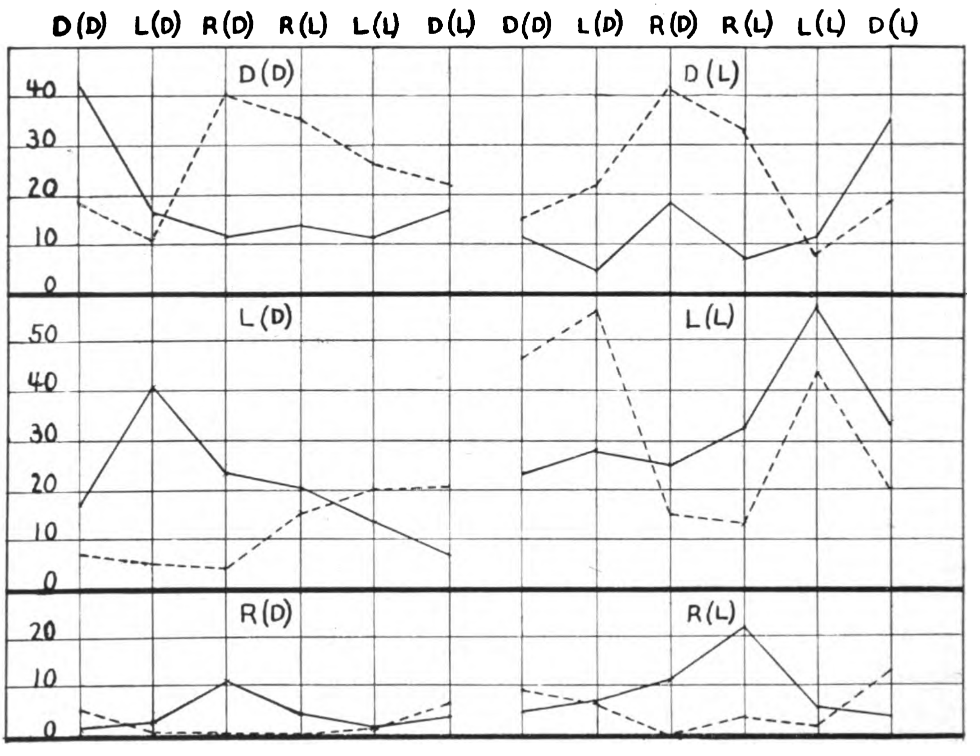
The view that albinism is, in general, due to recessive factors may safely be accepted, but it must be pointed out, as in the case of piebalds, that different factors may be involved in different families. The different grades may be due to multiple allelomorphs as found in albino rabbits, guinea-pigs, and rats or may be due to combinations of independent factors or both. It is easy to see that a dilution factor which would produce very little visible effect in the negro race might be enough to reduce a blond European to an albino with imperfect vision and nystagmus. Indeed blondness itself may be looked upon as a grade of imperfect albinism. Another problem is a curious relation of albinism to red hair. Davenport noted that among forty-two parents of albinos in his tables, eleven had some grade of red hair. This is above the usual per cent of red hair in the population involved. About 4% of the population in England, Scotland, or Ireland have distinctly red hair, according to Pearson. The number is larger if we include chestnut, auburn, and yellow. Data collected by Holmes and Loomis[10] at the University of Wisconsin contain 8.8%, including these colors. Pearson noted a similar excess of red among the relatives of albinos in the very extensive data referred to; 13.0% of the parents, 12.9% of the siblings, and 8.6% of the uncles and aunts showed some trace of red. Pearson also emphasizes the point that albinos may have yellow or even light red hair themselves.

These facts seem, at first, very difficult to explain when we recall that in rabbits, guinea-pigs, rats, and dogs, red is very much more quickly reduced to white than is black by grades of imperfect albinism. The subject will be discussed further when the data on the inheritance of red hair are examined. Here it is sufficient to note that albinism cannot always be a single unit. We may say that albinism in most families is due to recessive unit factors, but we must be cautious in identifying the albinism of different families with each other and with the albinism of lower animals.

THE COMMON VARIATIONS IN COLOR

Of more interest than the heredity of these unusual traits is that of the common variations in skin, hair, and eye color. Unfortunately the problems are much more difficult. When even such an uncommon color as red hair occurs in two relatives one can have no such assurance that the same factor is

[7]Castle, W. E., and W. E. Farabee, 1903, *Sci. N. S.*, 17.
[8]Davenport, C. B., and G. C. Davenport, 1910, *Amer. Nat.*, 44:705-731. 1916, JOUR. HER. 7:221-223.
[9]Apert, 1914, JOUR. HER., 5:492-497.
[10]Holmes, S. J., and H. M. Loomis, 1910, *Biol. Bull.*, 18:50-65.



HOW HAIR AND EYE COLOR ARE INHERITED

Solid line—per cent whieh those of each combination of hair and eyes color form of the relatives of the color combinations at the top of the figures. Broken line—per cent of those of each color combination form of the husbands and wives of the color combination at the top. D—dark hair, L—light hair, R—red, auburn or yellow hafr, (D)—dark eyes, (L)—light eyes. (Fig. 17)

responsible as in the case of traits which are peculiar to a few families. As noted, hair with sufficient suggestion of red to be called auburn is found in 8.8% of a random Wisconsin student population. If red were recessive this would mean that almost half the remaining population would be heterozygous. The situation is even more difficult to analyze in the case of the differences between dark and light hair or eyes, brunette or blond complexion, etc. Again, none of these common variations are obviously discontinuous. All grades of complexion between dark brunette and the fairest blond are common in persons of British descent. All variations in hair color between intense black through brown to flaxen and from black through the reddish blacks and auburns to clear red may be found in such a population.

EYE COLOR

Eye color shows more discontinuity than hair and skin color as there is rather of an abrupt transition between brown and eyes which show a distinctly greenish or bluish tint. Galton[11] considered human eye color a good example of discontinuous heredity. Nevertheless it appears that the discontinuity is superficial even here. Eye color is due to pigment deposited on both sides of the iris. There is also pigment in other parts of the eye, including the retina. In a series of eyes showing gradual reduction in pigmentation, the

[11]Galton, F., 1889, "Natural Inheritance."

granules disappear first in front part of the iris. With pigment on the back, but not on the front, the effect is blue. A bluish or greenish appearance comes in rather abruptly when the anterior pigment is reduced to a certain point. With further reduction of the quantity of pigment the iris becomes a pale gray blue as in albinos, and the parallel reduction in the retina reaches a point at which vision is impaired and a red reflex becomes visible through the pupil.

Hurst[12] and Davenport,[13] working independently, arrived at the conclusion that dark eye colors are dominant over the lighter colors. Hurst drew the line so as to include only the purest blues in the recessive class, considering presence and absence of pigment on the part of the iris as the opposed characters. Davenport drew no such sharp line, but concluded that any darker color was dominant over any lighter color. He recognized that the results were not wholly clear-cut and that complications must exist. Holmes and Loomis[14] were more doubtful as to the value of the Mendelian description. They found that the darker colors tended to be dominant over the lighter ones, but that inheritance often seems blending and that offspring might be darker than either parent.

Hurst based his conclusions on data from a single village in Leicestershire. As the data show that there is no appreciable assortative mating for eye color, the population may be assumed to be in equilibrium. A good test of the unit factor hypothesis can be made by considering the proportions of the different classes in such a population. Such a test applied to data in shorthorn cattle, in an earlier paper, pointed overwhelmingly to the unit factor hypothesis. In this present case, however, the result is not so favorable. The data are summarized below. By duplex, Hurst means an eye with pigment on both sides of the iris, by simplex one with only posterior pigment—*i. e.*, a clear blue eye.

Parents	Matings	Children		Expected children	
		Duplex	Simplex	Duplex	Simplex
Duplex x Duplex..........	50	240	18	221	37
Duplex x Simplex..........	69	187	137	201	123
Simplex x Simplex........	20	0	101	0	101
	139	427	256		

Among the children 37.5% are simplex. Among the parents 39.2%. The number of children from matings of simplex by simplex with random mating should be .375 x .375 or 14.1%. The actual number is 14.8%. The number from matings of simplex by duplex should be 2 x .375 x .625 or 46.9%. The actual number is 47.4%. There is, evidently, no appreciable assortative mating. As the number of heterozygous dominants must be twice the product of the square roots of the homozygous classes in a population which is in equilibrium, and is without assortative mating, we can deduce the number of the two kinds of dominants. Where x^2 is the proportion of recessive (37.5%), the proportion of homozygous dominants must be $(1-x)^2$, which equals 15.0%, and the proportion of heterozygous dominants must be 47.5%. From these figures, the number of simplex children which should be produced by each type of mating may be calculated. Thus duplex by duplex should produce 37 simplex children, much in excess of the number found (18)

[12] Hurst, C. C., 1908, *Proc. Roy. Soc. B.*, 80:85-96.
[13] Davenport, C. B., and G. C. Davenport, 1907, *Sci. N. S.*, 26:589-592.
[14] Holmes and Loomis, *loc. cit.*

while duplex by simplex should produce 123 simplex children considerably in defect of the number found (137). The discrepancies are so great that it must be concluded that some more complicated explanation must be adopted than that of a single unit factor.

In addition to the evidence above is the evidence that light eyed parents may have children with darker eyes than their own. There are a number of such cases in Davenport's data. Holmes and Loomis have several cases including one in which two blue-eyed parents had a brown-eyed child. The writer knows personally of two distinct cases. Summing up, we may say that the factor or factors for light eyes have somewhat more tendency to be recessive than dominant, but we cannot affirm that a single unit factor is the principal cause of differences.

HAIR COLOR

Turning to hair color, we find a similarly unsatisfactory situation from the Mendelian standpoint. Davenport[15] classifies variations in hair color into two independent groups. He considers the granular pigment of black and brown hair as wholly distinct, physiologically and genetically, from the diffuse red pigment of clear red hair. He holds that these two kinds of pigment can be mixed in any proportions. In the presence of the granular pigment the color is black regardless of whether diffuse pigment is present or absent. Diffuse pigment in the absence of granular pigment is responsible for red, while with both pigments absent, or nearly so, the color is white to flaxen. The relations may be represented in the following scheme in which intermediate colors have been introduced. Variations in amount of granular pigment are represented horizontally; variations in amount of diffuse pigment vertically:

Black	Reddish-brown	Red
Black	Yellow-brown	Yellow
Black	Brown	Flaxen

Objections can be raised to this scheme on theoretical grounds, based on our present knowledge of the relations of the colors in other mammals. In guinea-pigs, for example, we have black granules and diffuse red pigment (as well as red granules), which one can hardly doubt are closely similar to the human pigments.[16] In guinea-pigs, however, it is certain that red and black cannot be treated as independent physiologically. The same factors for piebald (class 1a) inhibit both colors in spots in the fur; factors in the albino series (class 1b) dilute both colors, while factors of class 2a, as the tortoise shell and agouti factors, may replace a black, which is unassociated with red pigment, by intense red. These statements hold good for factors in classes 1a, 1b, and 2a in all other mammals which have been discussed. However, it will be shown that a scheme which dffers only in theory from that above may be devised, which is in harmony with the relations of black and red in other mammals.

Davenport concluded, from a study of pedigrees, that the more intense condition of either pigment is dominant over the less intense. He gives abundant evidence that the lighter colors may be transmitted by dark haired persons. As in the case of eye color, however, we find rather numerous cases which do not fit the theory. Thus in one family, in Davenport's tables, flaxen by light brown produced red. In two cases, two light brown parents produced either auburn or red-haired children. In these cases, the children seem to have had more red pigment than either parent. Cases in which the children had more dark pigment than either parent are even more abundant, especially when we compare grandparents and parents in the table. It is not surprising, on any theory, that young children should seldom be darker than their parents, as the full intensity of hair color is not reached until maturity. In Davenport's tables we find two light brown parents producing dark or black-haired children in several cases. We find that red by red may produce black. In one remarkable case light

[15] Davenport, C. B., and G. C. Davenport, 1909, *Amer. Nat.*, 43:193-211.
[16] Hunt, H. R., and S. Wright, 1918, Jour. Her., 9:178-181.

brown by very light red produced the extremes of hair color—jet black and albino. Holmes and Loomis noted several cases in their records similar to those above, and many such cases can be found in the data of Pearson, Nettleship, and Usher. From all of these sources we get abundant evidence of segregation of some sort. It is clear, however, that if there is one main factor by which red and light brown differ from black, it must be imperfectly dominant, and that there must be other factors which raise or lower the pigmentation of the heterozygotes from one extreme to the other.

SKIN COLOR

With skin color the difficulties in study are naturally greater than with either eyes or hair color. As in the other cases, Davenport[17] concludes that the darker shades tend to be dominant over the lighter ones. Where wide crosses are made, as in the union of white with negro, it is well known that there is not unit Mendelian inheritance. The mulattoes are intermediate in color and their children are still mulattoes. Davenport has found, however, that there is much variability in the second generation, and that the results can be explained on the basis of two pairs of Mendelian factors, both imperfectly dominant. Here, again, it is impossible to speak of particular Mendelian factors as demonstrated. We can merely say that there is evidence for Mendelian segregation of some sort, and that the number of factors which need be hypothecated is not very great.

CORRELATED VARIATION

So far we have dealt with hair, skin, and eye color as wholly separate characters. In each case, we have been forced to conclude that the evidence has not demonstrated satisfactorily the existence of particular unit factors with clearly defined effects, but merely the presence of Mendelian segregation of a complex kind, with dominance tending toward the darker types, but probably imperfect as a rule. This is practically the conclusion reached by Holmes and Loomis in their study of hair and eye color, and, indeed, has been recognized, more or less, by all workers in this difficult field. But even if we were able to grant that the main effects are due to single pairs of unit factors in each case (considering only dark granular pigment), we would find great difficulty in accounting for the relations of these characters to each other. The three factors for dark hair, dark eyes, and dark skin, respectively, must either be identical or independent of each other. If identical, correlation in hair, skin, and eye color should be nearly perfect. If independent there should be no correlation, unless the population is one in which there is assortative mating. With partial linkage of factors, the correlations would still be zero. It would merely require a longer time for a heterogeneous population to reach equilibrium.

It is common experience that blue eyes tend to go with light hair and a fair skin. The degree of correlation, however, is far too low to harmonize with the hypothesis that there is merely one series of factors for all melanic pigmentation. Pearson[18] has calculated the correlations between hair and eye color in data from several nations with the following results:

Sweden (conscripts)	.250
Prussian (school children)	.271
Italy (conscripts)	.309
German Jew (school children)	.338
Baden (conscripts)	.354
Great Britain (school children)	.420

The correlations are so low that they might be suspected to be the result merely of racial heterogeneity. A correlation table involving all Europe would thus show a very high correlation simply because dark-haired, dark-eyed Spaniards and fair-haired, blue-eyed Scandinavians do not intermarry. It might be an accident from a physiological standpoint that both dilution of hair color and of eye color have become associated in the Scandinavian people.

[17] Davenport, C. B., 1913; Carn. Inst. Wash. Pub. No. 188, 1914, JOUR. HER., 5:555-569.
[18] Pearson, K., 1904, *Biom.*, 3:459.

It can be shown, however, that there is a real physiological correlation from other data. The evidence from the data of Holmes and Loomis will serve as an example.

This data were obtained from students at the University of Wisconsin. In 71 families fairly complete records of hair and eye color were obtained for all brothers and sisters, parents, and grandparents. The authors' conclusions have already been noted briefly. The data are worthy of further analysis. For the present purpose eye color is conveniently divided into two classes—dark and light. The division is made at the point at which a bluish or greenish tint is obviously present. Black, brown, light brown, and hazel are called dark, while green brown, gray, and blue are called light. Hair color is classified as dark, light, or red. By dark is meant only black in adults, but both black and dark brown in children. This compensates, in part, for the great change with age. The category red is made as wide as possible, including auburn, chestnut, and a few yellows, as well as dark and light reds. Even thus it includes only 59 individuals or 8.8%. The tables are based on 364 adults (parents and grandparents), and 305 children. Among the adults 136 are dark haired, 200 light haired, and 28 red haired. Among the children these classes number 81, 193, and 31, respectively. The adult males do not differ appreciably from the females in hair color, but have slightly lighter eyes (68% light in males, 58% in the females).

TABLE 1.—*Per Cent of Light Eyes Associated with Each Hair Color*

Hair	Adults	Children
Dark	41	42
Light	76	64
Red	75	68

Dark-haired persons clearly have light eyes much less frequently than do light or red-haired persons. That this is not due to assortative mating such as would be the case if the students came in part from Italian, in part from Scandinavian families, is shown by Table 2, in which the percentage of husbands and wives of those with the different hair and eye colors are given for each hair and eye color.

TABLE 2.—*Association of Hair and Eye Colors in Husbands and Wives by Per Cent.*

	Hair			Eyes	
	Dark	Light	Red	Dark	Light
Dark hair	41	46	13	33	67
Light hair	31	65	4	38	62
Red hair	64	29	7	54	46
Dark eyes	33	56	11	30	70
Light eyes	40	55	6	42	58
Average	37	55	8	37	63

Persons with dark hair showed some preference above the average for their own color, but also for red hair and for light eyes. Persons with light hair preferred their own hair color, but showed no marked preference in eye color. Those with red hair show a very marked preference for black hair and also for black eyes. Dark-eyed persons showed little preference in hair color, but chose light-eyed mates considerably in excess of the average. The converse of the last statement is true of light eyed persons. While the numbers are too small in most of these cases to attribute much significance to them, it is at least clear that there is no assortative mating which can account for the correlation between hair and eye color found in individuals. There can be no question that light hair is connected physiologically with light eyes. In the case of red hair, the difference between 72% light eyes among 59 red-haired persons and 41% light eyes among 227 dark-haired persons is significant and not due to assortative mating.

This conclusion that hair, eye, and also doubtless skin color are physiologically connected, finds abundant analogies in the lower mammals. Indeed we have found it to be the rule that dilution factors of any kind (as opposed to pattern factors) produce their effect

wherever there is pigment of the proper kind. Thus in such mammals as the guinea-pig in which at least three independent sets of factors dilute hair, skin, and eye color, it has been found necessary to consider simultaneously all of the effects of any factor in order to analyze the heredity. It would seem desirable to apply this method to human data. The data of Holmes and Loomis is admirably adapted to this purpose.

COMBINATIONS OF HAIR AND EYE COLOR CONSIDERED AS UNITS

Let us then consider as distinct color varieties, the six combinations of hair and eye color—dark, light, and red hair each with dark or light eyes, and investigate their relations. Tables in which grandparents and parents are compared together, parents and offspring, and offspring with each other give fairly consistent results. By combining all of the data into one table, however, the results are brought out more clearly, freed from some of the irregularities due to small numbers. The fact that both parental and fraternal correlations are usually about the same, viz., .50 for characters which are wholly genetic, will serve as a justification for this procedure. In making up the table, parents and offspring were entered in both subject and relative classes. In order that the fraternal correlation should not be given undue importance, each entry was weighted inversely as the size of the sibship. The usual method of making fraternal correlations gives a family of 15 a weight of 210, where a family of 2 has a weight of only 2. It seems fairer to weight a family according to the number of brothers of a random individual and so give these families weights of 14 and 1, or 28 and 2 after doubling to make comparable with the double entries in the parent-offspring correlations. It may be said in passing that the unmodified fraternal correlation brings out the same relations as those presented below, even more clearly. The relations are most clearly brought out by calculating the per cent of cases in which each color combination occurs in relatives of each kind. (Table 3.)

Thus by reading down a vertical column we find that light hair with dark eyes was the color combination of 17.0% of the relatives of brunettes, of 40.9% of the relatives of others with light hear and dark eyes, etc. In the tables D(L) means dark hair with light eyes, R(D) red hair with dark eyes, etc.

The high degree of heredity of each combination is the first thing which is revealed by this table. This point, however, shows that before going farther it will be well to examine the data for assortative mating. If light eyed red haired persons have a special preference for another color some evidence for which we have already noted, this color should be in excess among relatives, as well as red hair with light eyes. Table 4 gives the per cent of cases in which those of each color combination married persons with the same and the other combinations. This table gives some idea of marriage prefer-

TABLE 3.—*Per cent of the different color combinations among relatives of those with each color combination (reading horizontally). For measurement of degree of association of one color combination with the others, read vertically. Based on 233 pairs of grandparents, with parent, 608 of parent with offspring and 242 random offspring with offspring. Each pair entered twice, making table symmetrical before calculation of per cents.*

	D(D)	L(D)	R(D)	R(L)	L(L)	D(L)	
D(D).........	41.7	17.0	1.6	4.7	23.5	11.7	100.2
L(D).........	16.8	40.9	3.1	6.8	27.9	4.5	100.0
R(D).........	11.7	23.3	10.7	10.7	24.9	18.6	99.9
R(L).........	13.9	20.5	4.3	21.9	32.3	7.0	99.9
L(L).........	11.3	13.6	1.6	5.2	57.3	11.0	100.0
D(L).........	17.1	6.7	3.7	3.4	33.6	35.5	100.0

ences, but more important from the standpoint of heredity is a similar table in which the marriages are weighted by the number of relatives in Table 3 connected with each. In Table 5 the marriages were weighted by the number of the children with an additional weight of one-third in the parental entries (as opposed to the grandparental) in order to balance approximately the fraternal correlation among the children in Table 3.

The results are presented graphically below. In these diagrams, the solid lines represent the per cent of cases in which a given combination is found in relatives of the various kinds, and the broken lines represent the similar percentages for matings (weighted).

NONASSORTATIVE MATING

The graphs on the whole tell a very consistent story. The heredity of the different combinations is obvious. In each of the cases those of a given combination form a larger per cent of the relatives of their own color than of any other. In a general way the colors fall into the order of relationship in which they are here arranged. Dark eyed dark, dark eyed light, dark eyed red, light eyed red, light eyed light with light eyed dark completing the cycle, showing relationship to dark eyed dark as well as light eyed light. A consideration of merely the correlation among relatives, however, gives a very imperfect idea of the connection between the colors. There is approximately at least equal transmission by the parents so that one would expect that the combination for which a given color shows most preference in marriage would also show preponderance among the children. But it happens to a surprising extent that the reverse is true. In general these people seem to have preferred to marry those of the color combination most remote from their own, so that where the line of preferential mating is depressed the line of relatives is elevated and the reverse. In order to give a rough measure of the nonassortative mating, the rank of frequency as a husband or wife was tabulated against the rank of frequency as a relative for each color in connection with each color. This means that rank in the vertical column in Table 3 was correlated with

TABLE 4.—*Per cent of marriages of each kind made by each kind of individual (reading horizontally). For measurement of degree of assortative mating (or reverse) read vertically. Based on 182 marriages.*

	D(D)	L(D)	R(D)	R(L)	L(L)	D(L)	
D(D).........	17.3	9.9	2.5	12.4	44.5	13.6	100.2
L(D).........	17.0	8.5	2.1	4.3	51.1	17.0	100.0
R(D).........	28.6	14.3	0.0	0.0	28.6	28.6	100.1
R(L).........	47.6	9.5	0.0	9.5	14.3	19.1	100.0
L(L).........	23.5	15.7	1.3	2.0	51.0	6.5	100.0
D(L).........	20.0	14.6	3.6	7.3	18.2	36.4	100.1

TABLE 5.—*Same as Table 4, except that the number of marriages of each kind is weighted by the number of offsprings produced and the parental generation is given more weight than the grandparental. (See text.)*

	D(D)	L(D)	R(D)	R(L)	L(L)	D(L)	
D(D).........	18.2	7.0	4.5	9.0	46.6	14.8	100.1
L(D).........	10.8	4.9	0.7	6.0	55.9	21.7	100.0
R(D).........	40.1	3.9	0.0	0.0	14.4	41.6	100.0
R(L).........	35.5	15.4	0.0	3.4	12.5	33.1	99.9
L(L).........	26.0	20.2	0.9	1.8	43.5	7.6	100.0
D(L).........	21.8	20.7	6.9	12.4	20.0	18.4	100.2

rank in the vertical columns of table 4 or 5, making correlation Tables with 36 entries.

The correlation between rank among relatives and rank among husbands and wives is —.51 when the latter are weighted, —.28 when unweighted. The difference seems to be due largely to a smaller degree of nonassortative mating among the grandparents than among the parents. Where the matings are unweighted the grandparental matings are, of course, more important than the parental.

TWO KINDS OF DILUTION OF EYE COLOR

The results as to the connection between the different color varieties agree in the main with those to be expected on any theory. One would expect to find D(D) closer to either D(L) than to L(L), and D(L) closer to D(D) and L(L) than to L(D), whether hair and eyes are inherited independently or in part together. Perhaps the most important point which is brought out is the very low relationship of R(L) to D(L) and the high relationship to L(D). We have seen that there is a physiological relationship between red hair and light eyes. It seems necessary to suppose that the same factor which reduces the amount of black pigment in the hair and permits red to appear in its place, reduces black in the eyes. But we cannot suppose that factors of this class are responsible for the light eyes in black haired persons. Thus as a basis for classifying the color varieties it would seem to be a good working hypothesis to suppose that two fundamentally different kinds of dilution factors for eye color are at work. One also reduces black hair to red hair; the other has no such effect. Since, however, both D(L) and R(L) are quite closely related to L(L), we may go a step farther and suppose that the same factors which reduce D(D) to D(L) reduce R(L) to L(L). These relations may be indicated briefly as follows:

D(D) R(L)
D(L) . L(L)

Let us compare the effects of these hypothetical factors with the classes of color factors found in mammals. A factor which reduces red to flaxen or white, in extreme cases, must be placed in class 1b with the albino series in the lower mammals. These are factors which are supposed to reduce the amount of the fundamental enzyme for color production (enzyme I). Such factors should produce a dilution of black pigment in hair and eyes as well as of red in the hair, but the dilution should be very much less marked in the black hair. The other class of dilution factors—that which reduces D(D) to R(L) must be placed in $2a_3$ or 2b. Such factors produce a general reduction in quantity or strength of enzyme II, and leave enzyme I free to develop red pigment. A fairly close parallel can be taken from relations which the writer has found to hold in guinea-pigs. The albino series of four alleomorphs C, C_d, C_r, and C_a may be taken to represent class 1b, *i. e.*, general pigment dilution. The pair extension of black (E) and restriction of black (e) of class $2a_2$ may be taken to illustrate a factor which replaces black by red. The parallel is not complete here, as factors E and e belong to a series in which an intermediate allelomorph E_p produces tortoise shell. The series changes black to red by way of a pattern of spots, eyes remaining unaffected, instead of by way of a general dilution which may be expected to affect the eyes.

The colors called dark and light sepia in guinea-pigs in the earlier papers are here called black and dark brown, the human hair colors which they match. The dark sepia of C_dC_d, C_dC_r, and C_rC_r is, as a rule, sufficiently browner than the black of C — to be distinguishable but is fully as black as the average black hair in Europeans. The light sepia of C_rC_r and C_rC_a is light only by comparison with dark sepia. Typical samples match very closely human hair which would be called dark brown. It will be seen that the arrangement of hair colors suggested for man is the same for the common colors as that adopted by Davenport, but the theoretical interpretation is quite different and brings the eye colors into the same scheme.

	Guinea-pigs		Man			
	EE	ee				
C	Black (B)	Red (B)	B(B)	Au(Br)	R(Blue)	R(Blue)
C_dC_d	Black (B)	Yellow (B)				
C_dC_r	Black (B)	Cream (B)	B(Br)	Br(Br)	Y(Blue)	Y(Alb)
C_dC_a	Dark Brown (B)	Cream (B)				
C_rC_r	Black (Red)	White (Red)	B(Blue)	Br(Blue)	W(Blue)	W(Alb)
C_rC_a	Dark Brown (Red)	White (Red)				
C_aC_a	Sooty White (Pink)	White (Pink)	W(Alb)	W(Alb)	W(Alb)	W(Alb)

B, Au, R, Br, Y, and W stand for black, auburn, red, brown, yellow and white hair respectively (B) (Br) and (Alb) stand for black, brown and albinotic eyes.

Instead of supposing that the factors by which black differs from red determine the presence of a granular pigment wholly independent of a red, we suppose that an additional enzyme (enzyme II) is determined which converts the fundamental enzyme, which alone produces red, to an enzyme which can produce black. The same effect is supposed to take place in the eyes and skin as in the hair. The change from white or flaxen to red is interpreted as being due to an increase in the fundamental enzyme (enzyme I) instead of the addition of diffuse red pigment wholly independent of black. As in the other mammals, we suppose the threshold for production of red (enzyme I acting alone) is at so much higher a level than the threshold for black (enzyme I assisted by enzyme II) that we find white or flaxen in place of red at a level at which we find black virtually unchanged.

We would expect to find effects of the factors $2a_3$ on the skin as well as in hair and eyes. The general correlation has been alluded to. In the case of red, Pearson has shown that freckling is especially characteristic of red haired persons.

ALBINISM, BLONDNESS, AND RED HAIR

The question now arises as to the position of albinism in this scheme. If we take the condition of the eyes—pale iris, red pupil, nystagmus, photophobia, and poor vision—as the fundamental criterion for albinism in man (rather than mere white hair), we see that such a condition may be reached by extreme variation along two routes. Extreme reduction of enzyme I should at length reduce the blue eyed black-haired type to a pale brown or even white with albinotic eyes, comparable to the albinos of rodents. Doubtless most of the albinos of dark races are of this type since the chances are that such a rare variation differs from the normal by only one factor. The evidence on the whole indicates that such albinism behaves as a unit recessive factor. Such albinism doubtless also exists in the white race, but is not easy to distinguish from the second kind. The second kind of albinism we find in Pearson's red and yellow haired albinos which suggest extreme reduction of enzyme II, rather than of enzyme I.

These red and yellow haired albinos, however, appear to be very uncommon. But the observation of Davenport and Pearson in regard to the unusual frequency of red haired persons among the relatives of albinos of the ordinary white haired kind suggests that we are here dealing with the combined effects of both kinds of variations. Thus variations of class $2a_3$, which alone may reduce black merely to a blue eyed red, only a little more extreme than usual, when associated with a grade of general dilution which will reduce red to white, but black eyed black merely to blue eyed black, should result in a blue eyed white type with more or less albinotic eyes. Such an albino would be closely comparable with the red-eyed white guinea-pigs (see C_rC_r).

The main difference is that such red eyed white guinea pigs have no more dilution of the eyes than red eyed black ones (EE C_r C_r), a point explained by the different character of the guinea-pig restriction factor (of class $2a_2$) and the human variation for red hair of class $2a_3$. The evidence does not yet warrant the acceptance of any unit factors for either of these kinds of variations in man, though there is much evidence of segregation. If we suppose that black is only imperfectly dominant over extreme reds (evidence for which has already been noted) we can easily account for the numerous auburn and chestnut browns among the relatives of European albinos.

COLOR AND RACE

This leads to a consideration of the racial distribution of human color variations. Pearson and his collaborators have shown that dilute variations, probably of both kinds, occur occasionally in all or most of the dark-colored races. Dark hair with green eyes and reddish-brown hair with dark eyes are found as well as the more extreme albinotic types. Such variations could doubtless develop blond races, if given an advantage in selection. In most parts of the world, however, such variations with their lack of adaptation to excessive sunlight are rather selected against. In the foggy region of northern Europe, however, conditions are favorable. Here selections seems to have favored dilute variations of all kinds, probably largely through marriage. A traditional association of blondness with nobility or racial preeminence would lead to such a result. Around the shores of the Baltic and the North Sea we find typically blue-eyed, flaxen haired people, who, we must suppose, possess variations of both classes 1b and $2a_3$ to a marked extent. Among the Lithuanians and certain of the Finnic peoples along the east shores of the Baltic (Livs, Esths, Tchouds) this blondism reaches its maximum according to Pearson, Ripley,[19] and others. The hair is described as white or yellowish white, and the eyes, very pale blue. In Scandinavia, North Germany, and parts of Britain the same extreme blond type is common. Surrounding the area of extreme blondism we find a zone of segregating colors. Dark hair with blue eyes and red hair with different eye colors occur quite frequently as well as the fully blond or brunette types. The British Isles, northern France, southern Germany, and northern Russia are in this zone, and also the more remote parts of the world settled by descendants of these people. The data of Holmes and Loomis from Wisconsin is a good example of this zone. Outside of this zone of segregation, in Europe, are the typically brunette populations of Southern and southeastern Europe and Asia.

We have treated both variations of class 1b and $2a_3$ as centering around the Baltic and fading out in all directions. There is some evidence, however, that the zones of frequency of the two kinds of variations are not quite concentric. Dark red hair, according to Ripley, is characteristic of the Finns away from the coast (*e. g.*, the Votiaks and Zyrians). It is common even in Western Siberia, as among the Voguls and Ostiaks. Ripley also says that some tinge of red is almost universal in the Russians of the north and is common in Hungary and parts of Austria. It thus seems probable that dilution factors of class $2a_3$ are distributed much farther to the east than those of class 1b. In the west of Europe, the two kinds of variation seem to fade out more nearly together so that both black hair with blue eyes and red hair are common throughout the British Isles. However, black hair with pale blue eyes is most characteristic of the Gaelic speaking portions of Scotland and Western Ireland. Ripley speaks of this combination as highly characteristic of the Bretons and it is even said to be not uncommon in Spain. Apparently variations of class 1b have somewhat the greater western spread.

A difficulty in this interpretation of

[19] Ripley, W. Z., 1899, "The Races of Europe," 624 pp.

blondness must be met. Among the dark races, variations which produce relatively little dilution of hair color are apt to produce photophobia, nystagmus, and imperfect vision. But these eye defects seem no more common in Scandinavia and the surrounding regions than elsewhere. It is, however, quite likely that with selection for blondness of the hair, there would be selection against the accompanying eye defects. An adjustment in regional differentiation may thus have been reached by which eyes come to be affected less than skin and hair by the dilution factors. There is also some evidence from Pearson's data that in Scandinavia and Northern Germany eye colors are relatively darker for any given hair color than in the surrounding countries. Flaxen hair with dark eyes seems to be quite common there, while very rare, for example, in Great Britain.

The discussion so far has neglected racial lines. The anthropologists are generally agreed that there are three main racial types in Europe. They hold that Europe was originally inhabited by dolichocephalic races related to those of northern Africa and southwestern Asia. At present only the fringe of Europe has such types in anything like purity. The heart of the continent from the Balkans to France is inhabited largely by brachicephalic people, believed to be derived from the highlands of central Asia where similar people still live, connected with the European type through the Armenians of Asia Minor. This so called Alpine race is typically dark in hair and eye where found presumably in the greatest purity in Asia and southeastern Europe.

The original dolichocephalic races of Europe had an immense time in which to become differentiated from each other. These differences are manifest in the dolichocephalic peoples living now around the fringe of Europe. Thus the inhabitants of Southern Italy, Spain, and Southern France of the Mediterranean race are dark and relatively short. Among the older races of the British Isles somewhat different from either the Mediterraneans or the Nordics, the inhabitants range from medium (in Wales) to the tallest in Europe, and all are especially angular featured according to Ripley, and are rather dark. The Scandinavians, North Germans, and Finns of the Nordic race are rather tall, less angular in features and very fair. It is clear that the dilute variations arose among the northern dolichocephalic people probably with somewhat different centers of dispersal for the two kinds of dilution, as noted before. Constant mixture with the dark Mediterraneans, Alpines, and Mongols produced the zone of segregating colors.

CONCLUSION.

In conclusion we may say that certain rare traits peculiar to families such as premature grayness, piebaldism, and albinism (in some families) follow easily determined rules of inheritance. Premature grayness and piebaldism behave as unit dominants. Piebald in some families is sex-limited. Albinism is in certain cases a unit recessive. The common variation of eye, hair, and skin color cannot yet be said to be completely analyzed. The most important variations seem to be of two kinds. First is general reduction of color (class 1b), affecting red pigment and eye color at a higher threshold than black of hair, but producing general albinism in extreme cases. Black hair with blue eyes is caused by moderate variation of this kind. Second is dilution of black only (class $2a_3$) which affects hair, skin, and eyes, and in extreme cases produces a red haired type of albino. Red hair with blue eyes is typical of moderate dilution of this type. Combinations of the two kinds of variation produce the blond types which pass into more or less perfect albinism much more easily than when either type of variation is alone.

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WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

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NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX will contain only 8 instead of 12 numbers. Next year, if war conditions are no more unfavorable than this year, 9 numbers will be published.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Associaiton) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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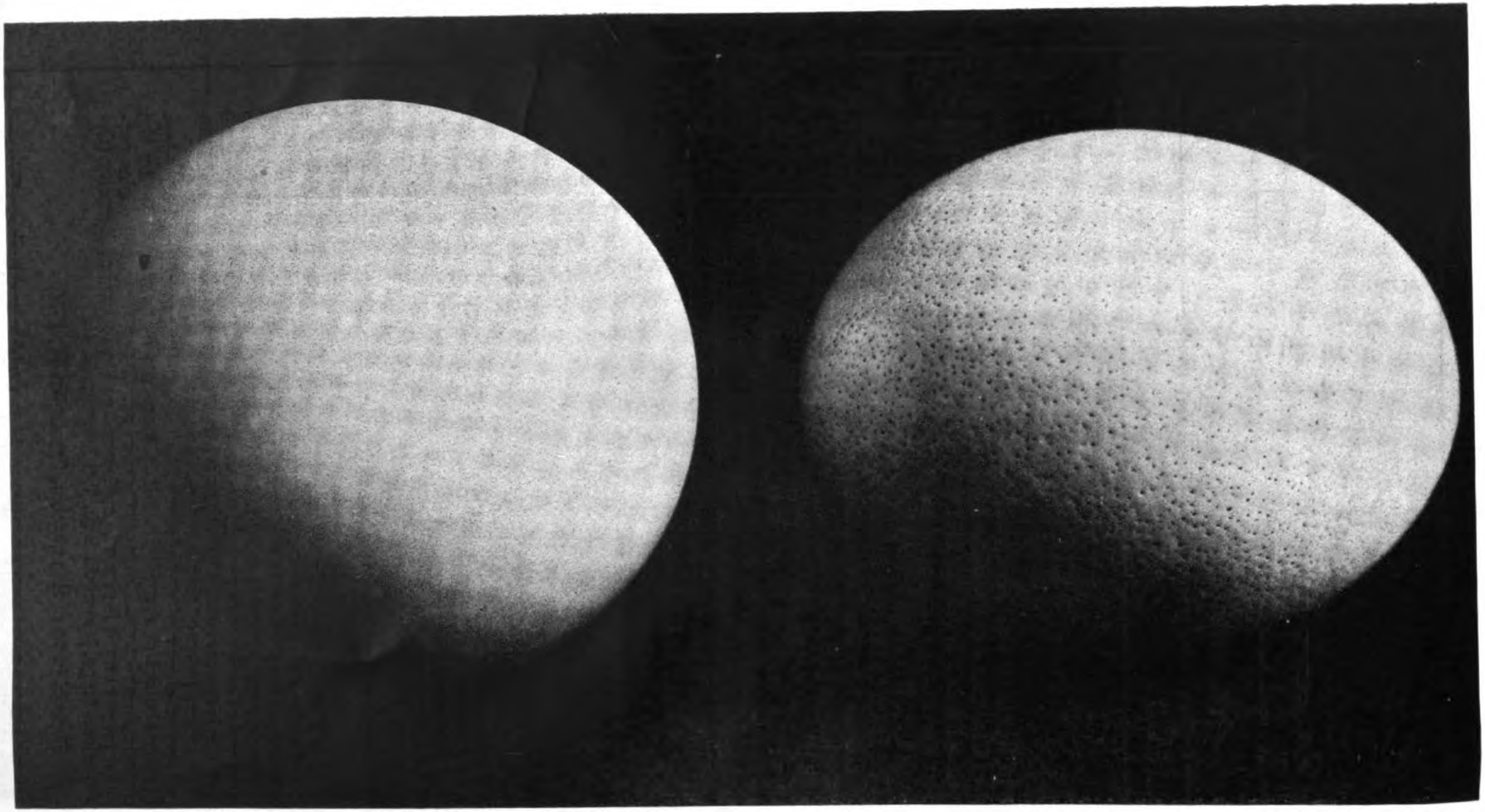


TWO SPECIES OF OSTRICH EGGS

The North African Ostrich Egg shown on the left is larger, rounder, and has a very different shell surface from that of the South African species shown on the right. The pores in the South African ostrich egg are conspicuous whereas in the North African they are too small to appear in the photograph. The North African Ostrich always lays an egg like the one shown here on the left, no matter what species of ostrich she has mated with. In other words, there is no evidence of xenia or influence of the father's characteristic upon the shell of the egg. The father's influence affects only the chick inside the egg. On the other hand the outside of a kernel of corn, which corresponds roughly to the shell of the egg, does show xenia. (Frontispiece.)

ABSENCE OF XENIA IN OSTRICH EGGS

South African Ostrich Hens Mated with North African Ostrich Cocks Lay Eggs Characteristic of Their Own Species—No Signs of Male Influence on the Egg Shells—No Xenia

J. E. DUERDEN, M.Sc., Ph.D.

Professor of Zoology, Rhodes University College, Grahamstown; Officer-in-charge, Ostrich Investigations, Grootfontein School of Agriculture, Middleburg, C.P.

IN THE JOURNAL OF HEREDITY for May, 1915, Vol. vi, No. 5, appears a review of certain investigations on xenia in fowls. By xenia is there understood "that the eggs laid by a hen are influenced as to size, shape and color by the cock with which she is mated." The occurrence of xenia in plants is first noted. Here cross-pollination is often found to have an influence on the character of the seed obtained directly from the cross, a result which is shown to be readily explained from the peculiar formation of the endosperm, where one of the two nuclei from the foreign pollen is involved in its production. The reviewer then discusses the various instances which have been adduced as showing some paternal influence on bird's eggs, especially those of Holdefleiss and Walther with fowls and Armin von Tschermak with canaries and finches. The conclusion arrived at is that "the evidence of xenia in poultry is certainly not adequate." The article closes with the statement that "the question is a recent one, and much work may yet be done on it, but until such work is done, xenia in fowls must be considered an open question."

Some recent work in crossing the North African and South African ostrich upon which the present writer has been engaged for some time affords very conclusive evidence in support of the above contention and, although distinctly negative in character, seems well worthy of record, since it represents such a clear cut test case. In 1912 the Government of the Union of South Africa imported 132 specimens of the North African ostrich from Nigeria with the object of possibly improving the domesticated Cape strains, built up during the past fifty years of ostrich farming from the original South African wild bird. The imported birds, originally captured by the Arabs from wild nests, were stationed at the Grootfontein School of Agriculture, and the breeding experiments in connection with them were placed in charge of the writer.

Zoologists generally recognize four species of the ostrich genus, *Struthio*: The North African ostrich, *S. camelus*, Linn.; the South African ostrich, *S. australis*, Gurney; the East African ostrich, *S. massaicus*, Naumann; and the Somali ostrich, *S. molybdophanes*, Reichenow. The two last mentioned are however not well established species, appearing to represent only intermediate types of the other two. On the other hand the northern and the southern birds have clearly defined distinguishing characteristics as regards bodily size and color, nature of the egg, and other minor features. Observing them side by side as can be done at Grootfontein, without any intermediate forms, no one would hesitate in assigning them specific distinction.

As in all other birds the eggs from the same ostrich and also from different ostriches vary within certain limits as regards size, shape and surface characters. But beyond these fluctuating variations several well defined and constant differences distinguish the egg of the North African from that of the South African ostrich; and it is the presence of these which affords such a decisive test as to the occurrence or

otherwise of xenia. The egg of the northern bird is always larger than that of the southern, the shell is almost free from obvious pores or pittings, and presents an ivory-like, smooth surface. Usually also the northern egg is rounder in shape or less oval, the two diameters being more nearly equal. On the other hand the egg of the southern bird is distinctly oval and is deeply pitted all over the surface, the pits often larger and more plentiful around the air-chamber end; and in consequence of the pittings the surface does not present the ivory smoothness of the northern egg. Both however are of the same cream color when freshly laid, becoming lighter on exposure. Among a number of eggs from northern and southern birds mixed together no mistake could possibly be made in separating the one kind from the other.

As regards actual dimensions the average long diameter of 43 northern eggs was 6.15 inches and the short diameter 5.35 inches; the average long diameter of 22 southern eggs was 5.96 inches and the short diameter 4.95 inches. Thus on the average the northern egg is about one-fifth of an inch longer and two-fifths of an inch broader than the southern egg; the former has an average weight of 3 pounds 11 ounces and the latter of 3 pounds 3 ounces. The mean difference in the two diameters is 0.8 inch for the northern and 1 inch for the southern, indicating that the former are rounder or less oval than the latter.

The pitting which gives such a characteristic difference to the appearance of the two kinds of eggs is associated with the respiratory pores of the shell. In the northern egg pores occur, but are so small and open so close to the surface as to be scarcely visible to the naked eye, and are mostly scattered singly with but little grouping. In consequence the surface appears almost uniformly smooth, though a fine pitting can be detected with a lens. In the southern egg the respiratory pores are larger, sunken below the general surface and mostly in small groups, varying from about six to twelve in a group. The close grouping of the sunken pores gives rise to the deeply pitted surface of the shell, often emphasized in the nest by the adherence of small particles of earth.

Whether the northern and the southern ostrich are to be regarded as distinct species depends largely upon one's conception of the term species. At any rate the two are found to interbreed freely and reciprocally, and the crosses or hybrids have also been proved to breed freely, both inter se and with either of the parent forms. About 200 eggs from the cross-matings have hitherto been obtained, both from Nigerian cocks mated with Cape hens and from Cape cocks mated with Nigerian hens. Breeding ostriches are kept apart from all others in large fenced camps, a breeding set consisting of a single cock and one or two hens; and there is never any possibility of confusion as to the pairings and the individual hen laying the twelve to eighteen eggs which constitute a nest.

The nests are visited from time to time to observe their progress, and in view of the possibility of xenia occurring the characters of all the eggs have been closely noted. Without any hesitancy it can be stated that *in no case have the eggs shown any influence from the cock; northern hens mated with southern cocks have always laid large, rounded, smooth, unpitted eggs and southern hens mated with northern cocks have always laid smaller, more oval, deeply pitted eggs.* The experienced eye can at a glance distinguish one kind of egg from the other as regards size, shape, nature of the surface and pitting; and in no instance have the eggs been different from those which one would expect from the hen irrespective of her mating, or even when unmated.

It can therefore be regarded as established that so far as concerns the egg of the ostrich there is no evidence whatever of the phenomenon of xenia. The size of the ovum, amount of albumen and nature of the shell are the characteristics of the hen just as much as are the external bodily features, and are uninfluenced by the cock with which she is

mated. Knowing the facts of the case this is certainly what any biologist would expect, though there is no á priori reason why the presence of spermatozoa in the oviduct should not affect the secretion of albumen and shell material; hence it may be that in other birds some undoubted influence from the cock may yet be established and thus constitute a true case of xenia.

EGGS FROM CROSS-BRED OSTRICHES

Naturally the fertilized germ within the egg from a cross-mating has very different potentialities from the fertilized germ of a mating where both parents are pure, even though the shell is uninfluenced; and the ostrich derived from the cross-fertilized egg has been found to reveal the influence of both parents. The various dimensions and colors of the body and the characters of the plumage all show intermediate stages between those of the northern and the southern birds, while a bald head-patch occurring in the northern and absent from the southern is found to be dominant, being present in all the cross-bred chicks.

The egg laid by a cross-bred hen as regarded its size, form and surface is, as observed above, quite as much a feature of the bird as are the characters just mentioned, and may be expected to follow the one parent or the other of the hen or partake of the nature of both. It is here that the influence of the cross-mating reveals itself, not in the egg laid by the parent hen with which the cross is made. The average long diameter of 34 eggs laid by cross-bred hens is 5.99 inches and the average short diameter 5.06 inches, which are practically the same as those of the southern egg (5.96; 4.95), but smaller than the northern (6.15; 5.35); the average difference in diameter is 0.93 inch as compared with the 1 inch of the southern and the 0.8 inch of the northern egg. Thus the size and shape of the cross-bred egg follow those of the southern bird rather than the northern. The pittings however are intermediate in number and depth. Obvious pittings are found over the shell of eggs from cross-bred hens, compared with their absence in the northern egg; but are neither so plentiful nor so deep as in eggs from southern birds; the general surface is also more ivory-like than in the southern bird but not so uniform as in the northern.

The eggs therefore laid by a cross-bred hen reveal undoubted influence from the cross-mating; and the experiments have further shown that the characters are unaffected according as the cross-bred hens are mated with cross-bred cocks or with a pure northern or a pure southern cock. The conclusion reached is that in all cases the egg remains unaffected by the cock bird, thus demonstrating the absence of xenia as unmistakably as in the first cross-matings.

WHY NAVEL ORANGES ARE SEEDLESS

A. D. Shamel, *Riverside, Calif.*

THE fruits of the Washington navel orange variety are seedless. The reason for this condition is that the flowers from which the fruits develop are not pollinated.

The Washington navel orange flowers are perfect except that the anthers do not develop pollen. The arrangement and the development of the flowers of this variety are similar to that of seedy varieties of oranges with the important exception of the production of pollen.

The writer has repeatedly pollinated Washington navel orange flowers with pollen secured from the flowers of pollen-bearing citrus varieties as, for example, the Valencia orange. The Valencia pollen was simply dusted over the receptive stigmas of the Washington navel orange flowers. Such flowers, with the exception of those accidentally destroyed, have invariably developed into navel oranges bearing viable seeds.

SOME SEEDY ORANGES FOUND

Occasionally a Washington navel orange containing one or more seeds has been found in the crops from our performance record trees. About ten such fruits have been found in a total of more than twenty-five thousand examined. This condition may be explained on the grounds of the accidental transfer of pollen from neighboring pollen-bearing citrus flowers through the agency of the common honey bee. During the blooming period bees are always extremely active in securing honey from orange blossoms. They probably accidentally pollinate a few pollenless flowers of the Washington navel orange located near Valencia or other pollen-bearing citrus varieties.

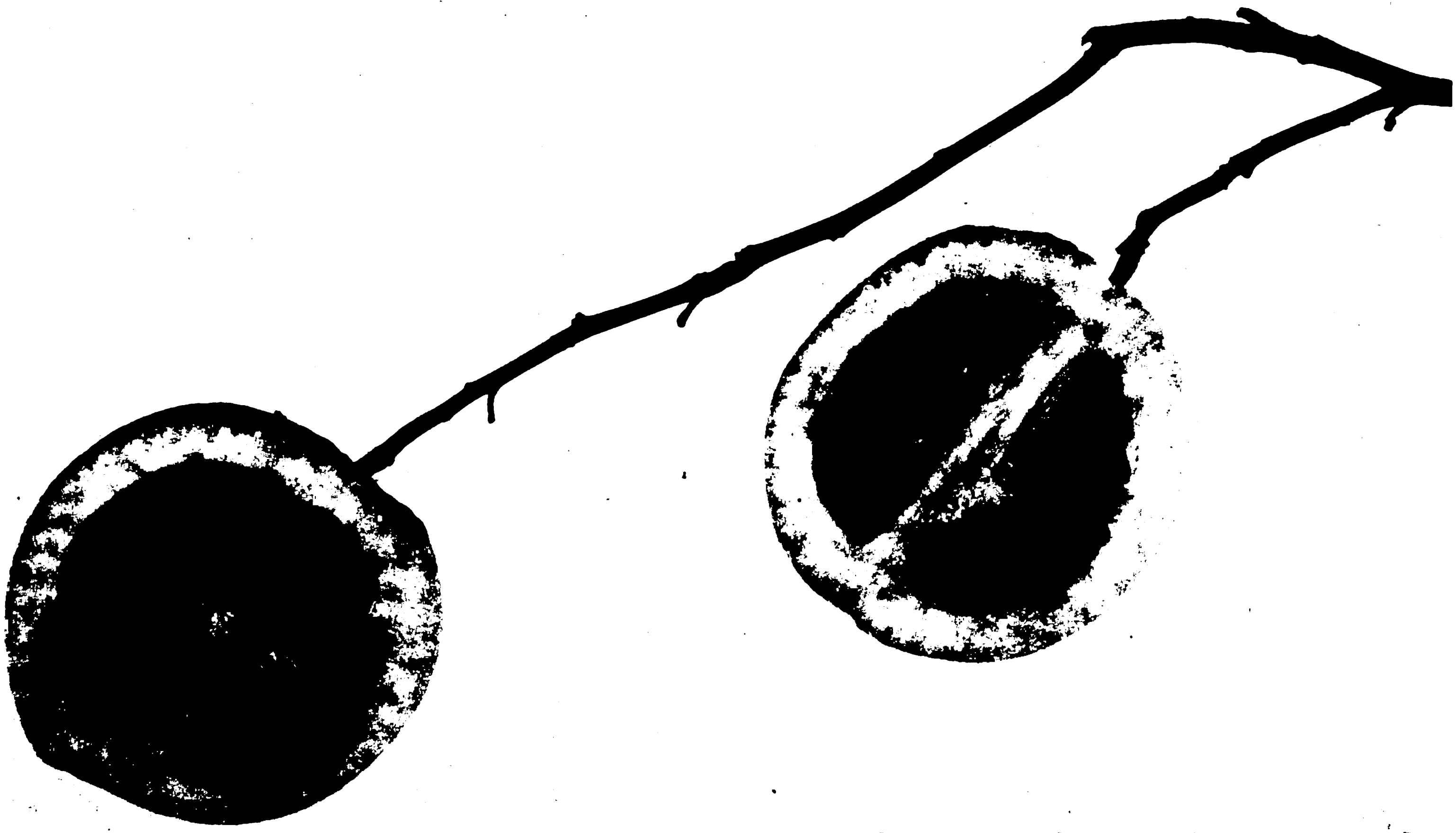
In the crops from the Ruby blood orange performance record trees many fruits are found every year with well-developed navels. The growers of this variety usually explain the presence of navels in the blood oranges as being due to cross-pollination with the navel orange variety. Such is not the case. The navel blood orange fruits are true bud variations. They occur as single fruit, branch, or entire tree variations of the Ruby blood variety. Some of the blood navel fruits are seedless, but usually they contain seeds. The flowers, so far as studied, are perfect and the anthers develop an abundance of viable pollen. The lack of pollen in the flowers of the Washington navel orange is further evidence that the navel blood fruits are not in any way the result of cross-pollination.

A SEEDY STRAIN

An interesting strain of the navel orange bearing seedy fruits was discovered by the writer near Riverside, California, in 1910. The fruits were habitually fully seeded, usually one seed being found in each section of both the primary and secondary parts of the fruits. The trees and fruits have apparently the same characteristics as those of the Washington navel orange except that the anthers of the flowers develop viable pollen. The seedy strain navel orange flowers also differ from those of the seedless navel orange flowers in that some of the stamens are usually abnormal. Some of them develop a petal-like appearance and anthers which may or may not contain pollen, as can be seen by a close inspection of the accompanying illustration. The seeds in the seedy strain navel orange fruits are due to the pollen-bearing characteristics of the flowers from which the fruits develop. At the time when the stigmatic surface of the pistils of the seedy navel orange strain flowers becomes in a receptive condition, the filaments grow with astonishing rapidity. They thrust the anthers past the stigmas before the petals open. As the anthers brush past the stigmas they burst open and an abun-

NAVEL ORANGE BLOSSOMS

The ordinary seedless navel orange is produced frcm a flower like the one on the left; without pollenation. The light colored short stamens which appear like a crown around the glistening dark pistil bear no pollen. Their anthers are empty. The occasional seedy navel orange is produced by flowers like that on the right which has long stamens, sometimes petal like in character, with large plump anthers filled with pollen. (Fig. 1.)



A NAVEL ORANGE AND ORDINARY ORANGE FROM THE SAME BRANCH

The Ruby Blood Orange is normally a seedy orange without a navel (the navel **is a** miniature orange imbedded in the tip or blossom **end of the full sized orange**). The photograph shows, produced on the same branch, a Ruby Blood orange of the ordinary type and at the tip of the branch a navel orange of the Ruby Blood variety. This is a case of true bud variation and not a result of pollenation from a navel orange flower. The fruits are cut open lengthwise. The navel appears as a light area in the tip. (Fig. 2.)

dance of pollen falls on to the sticky stigmatic surface. Here the pollen grains germinate and send their pollen tubes down through the pistil to the ovules where fecundation takes place.

LUDICROUS MISTAKES MADE

The lack of pollen in the flowers of the Washington navel orange variety is responsible for some rather ludicrous mistakes by some so-called breeders of new orange varieties. Every little while the writer receives a letter from, or comes into contact with, men who claim that they have originated a wonderful new orange by crossing the Washington navel orange with the Marsh grapefruit or some other citrus variety. Usually, they say that the pollen from the navel orange flowers has been used in making the alleged cross. An examination of the navel orange trees from which they claim to have gotten their pollen has invariably, so far, revealed the fact that there was no pollen in the flowers borne by these trees. These men, in some cases old orange growers, become very angry when the pollenless condition of their Washington navel orange flowers is pointed out to them.

The seedless characteristic of the navel orange is thus explained by a recent visitor to Southern California: "When the navel oranges are young the growers go about with a knife and perform an operation. The scars left by the knife when the seeds are cut out can be plainly seen at the ends of the oranges."

Stallion Enrollment Work for 1917 in Indiana

In spite of the fact that the number of mares bred last year was smaller than usual, the Purdue University Agricultural Experiment Station, in Circular No. 73, reports an increase in the number of registered pure-bred stallions and a decrease in the number of grade and scrub stallions and jacks enrolled.

The year 1917 passed with very satisfactory relations between stallion owners and the Enrollment Board. Owners secured their renewals earlier than ever before, and on March 15 it was found that but few were still delinquent.

Due to the fact that the market price of horses has not advanced as has that of cattle and hogs, the amount of breeding done was below the average, but that which was done appears to have been carried out along scientific lines. Many communities have organized horse breeders' associations, and through these are helping establish breeding on a sound basis.

Butter Fat Percentage Independent of Age of Cow

In the study of factors for production it is very important to know if there is any correlation between age and butter fat test in cows. The mean yearly fat test of eighty-six cows in the Delaware College herd has been studied in relation to age of the cows. Some of these cows have more than one record, and the number of records studied is 104.

The ages of the cows range from one and one-half to fourteen and one-half years, and the mean yearly fat tests show a range of from 3.25% to 7%. The standard deviation in age is $2.54 \pm .119$ years. The standard deviation in fat test is $.74 \pm .035\%$.

The coefficient of correlation, calculated by the usual formula, is $-.196 \pm .064$. Since this coefficient is barely three times the probable error, it cannot be considered at all significant.

The only deduction that follows, therefore, from these studies is that the butter fat test of the milk of a cow is not at all influenced by the age of the cow. This being the case, the study of the hereditary behavior of the percentage of butter fat in the milk of cows of different ages does not in any way affect the accuracy of the results.

THE COW IN CALF DESERVES MORE HONOR

Register of Merit of American Jersey Cattle Club Reveals Discrimination Against Cow Carrying Calf During Test Period—Young Cows Now Given the Advantage

J. J. Hooper

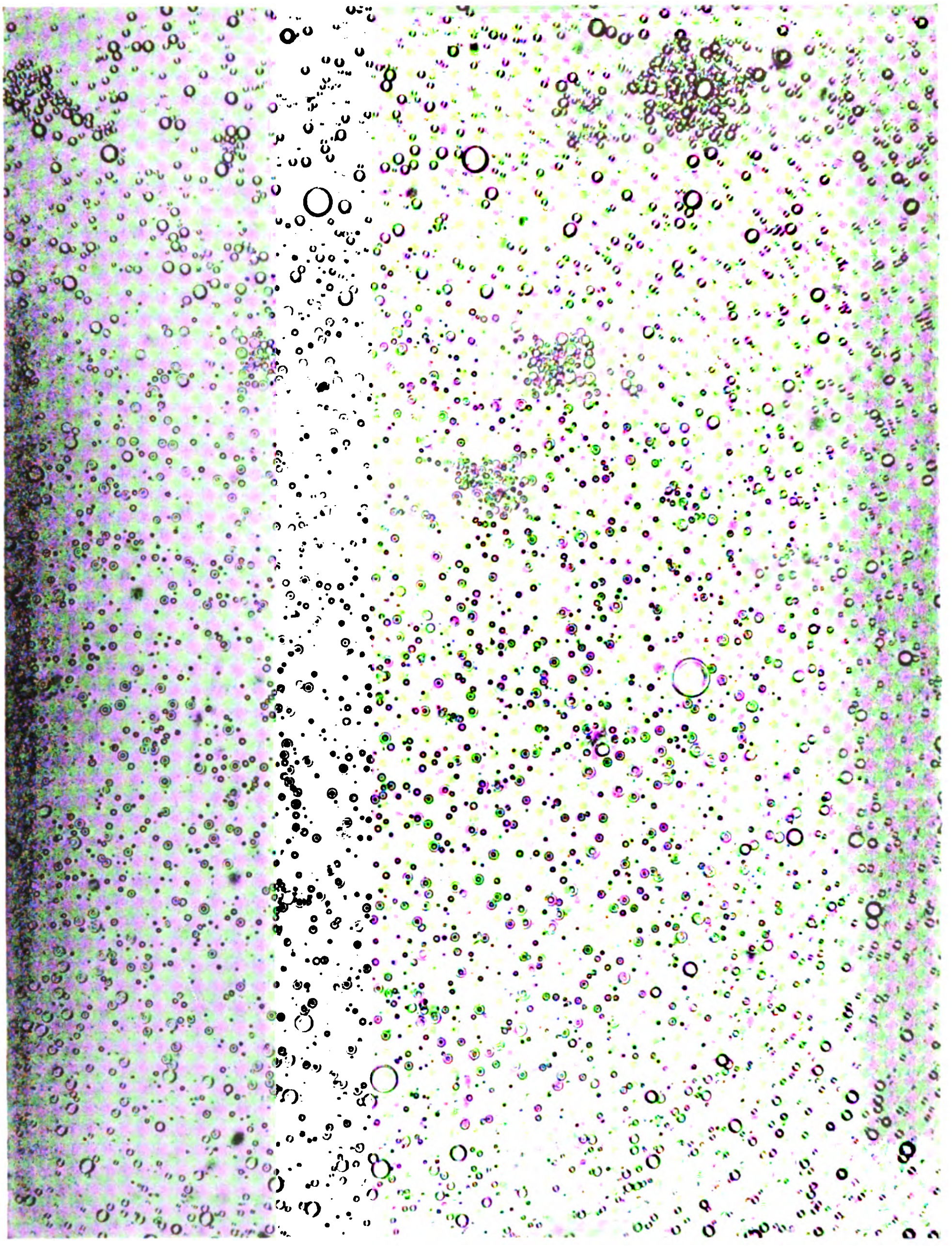
Kentucky Agricultural Experiment Station

IT is recognized that breeders of dairy cattle have attained remarkable results in the past decade in increasing the productivity of cows. The standard that has been adopted by breeders of Jersey cattle for Register of Merit cows stipulates that they shall produce at least 250 pounds of fat when two years old (or younger) and one-tenth of a pound more of fat for each day that they are older, until they reach five years of age when the maximum requirement of 360 pounds of fat has been attained. This applies to tests covering a year. No requirement is prescribed for the quantity of milk. It is quite obvious that the standard should be correct and that it should be equally proportioned for all ages. It is hardly fair to place a greater burden on young cows than on old ones, or vice versa.

In this study we have tabulated records of 1,497 Register of Merit cows entered in the volume that was published in 1916. We have kept the records of the A class of cows separate from those of the AA cows. The A cows are not required to carry a calf during the period of their record, while it is stipulated that the AA cows shall carry their calves at least 155 days covered by their test. It is believed that the AA cows are handicapped by carrying a calf *in utero* while making a test and accordingly they are given higher rating by being designated as AA cows.

By reference to the table (See Appendix) it will be found that the A cows averaged a little higher in milk and fat production than the AA cows. It seems that they have a little advantage in that they are only performing one function, that is, milk production while the others are performing two functions, namely, milk production and also the growth of a calf *in utero*. At the same time there is not very much difference in their records, as will be observed by referring to the table or to the graph. There it is shown that for the one- and two-year-old cows there is very little difference between the two classes, but they separate more widely from four to eight years of age. In other words, it seems that a very young cow, with her wonderful vitality, can perform the two functions easily, but at the age of four years she is taxed heavily to carry a calf, in comparison with an A cow. When the cows reach the age of eight to ten years they seem to again possess the ability to carry a calf, without serious detriment to their milk and fat production, in comparison with the A cows. From this study it appears correct that the cows that carry calves for five months or more of the test period deserve some recognition above the other cows, and especially is this true between the ages of four to eight years.

Another interesting point brought out in this study is the fact that the A cows increase in fat and milk production steadily until they reach the age of four years, when they seem to attain almost their maximum production, while the AA cows continue to rise in production until they are five years old, apparently maturing a year later than the A cows.



A DROP OF MILK

The thousands of different sized round bodies like floating bubbles shown in the photograph are the butter fat globules which in churning are packed together and make butter. The very small dark bodies are not fat. It is these butter fat globules which contain one of the essential vitamines (fat soluble A) necessary for the growth of the human body and it is this fat of the cow which the European world is starving for. The Chinese and Japanese have not become dependent upon it and if their cattle were all destroyed they would not suffer as Europeans have. They get their fat soluble A direct from large quantities of fresh vegetables. If the milk were richer, the fat globules would be larger and more closely crowded together. It is both the amount of milk and the quantity of these globules which are taken into consideration in grading cows. Photograph enlarged 350 diameters by John Howard Paine. (Fig. 3).

YOUNG COWS EXCEED REQUIREMENTS

Possibly the most important point developed in this study is that one- and two-year-old cows greatly exceed their requirements. It has been prescribed that two-year-olds shall produce 250.5 pounds of fat in a year. We find that they actually produce 359.2 pounds of fat. 250 pounds is 69.7% of 359 pounds. In other words these cows produce, in round numbers, 30% more than required. As they grow older the percentage of excess declines year after year, until the ten-year-old cows, that are required to produce 360 pounds of fat, produce actually 463 pounds. 360 pounds is 78% of 463 pounds, and these old cows only exceed requirements, therefore, by 22%. Under the present rules the younger cows have an advantage. If it is desired to standardize the matter so that cows of various ages shall have to produce a quantity of fat in proportion to their demonstrated capacity, then a standard similar to that in column D should be adopted.

Refer first to column A. The two-year old cows have been used as a standard, and column B constructed. Their standard of 250.5 pounds is 30% below their actual production of 359 pounds fat. The standard for ten-year-old cows, 360 pounds, is 22% below actual production of 463.8 pounds. In other words, to give them a similar standard to the two-year-olds would mean that they be required to yield 323 pounds of fat. Or, if we put the young cows on the same basis as the old cows and allow two-year-olds a differential of only 22% of their actual production, then the requirements for two-year-olds should be raised to 280 pounds of fat. As an average the standard is 25% less than production. and we have arranged column D on that basis. The standard in column D would be more fair and just to all ages than the present standard, if our records, embracing 865 A cows are sufficiently extensive to justify a conclusion. We believe more of the old cows would be found in the volumes if this standard, given in column D, were adopted.

PROBLEMS SATISFACTORILY EXPLAINED

The reason we made this study was that we believed the young cows have an advantage, and we are sustained by the data reported upon, but the error is not a serious one. We believed also that it was not very difficult for a cow to carry a calf and produce as large a test as an open cow. Here we were mistaken, because the data show that the AA cows work at some disadvantage, and should receive more honor for making a test that will qualify them for entry in the Register of Merit. We congratulate the American Jersey Cattle Club on the accuracy and correctness of the principle on which the work is based and carried out.

ARTIFICIAL HYBRIDS BETWEEN PIKE AND PICKEREL

Crossing Which Is Possible Artificially Appears Sometimes to Occur in Nature —Peculiar Specimens Which Are Occasionally Found Are Probably not Mutants, but True Hybrids

G. C. EMBODY

Cornell University, Ithaca, N. Y.

THOSE who have collected and studied the northern pike (*Esox lucius*) from Cayuga Lake, New York, have occasionally come across specimens showing, in one character at least, a condition intermediate between the typical pike and pickerel (*Esox reticulatus*). The question has arisen, whether this is a mutation or has been brought about by natural crossing of the two species. In order to shed some light on the question the writer has studied the spawning behavior of both forms, has determined the spawning time and lastly has crossed the two artificially, rearing the hybrids to a sufficient size to show their principal characters.

In the southern end of Cayuga Lake, the pike begin to enter the marshes and temporarily submerged fields as soon as the ice leaves, which is usually towards the middle of March. Spawning seldom occurs, however, until a week or more later when the temperature of the water approaches 8° C. The pike are accompanied, or closely followed, by the pickerel both in migration and time of spawning. It happens, therefore, that the two species may be spawning over the same area and at the same time.

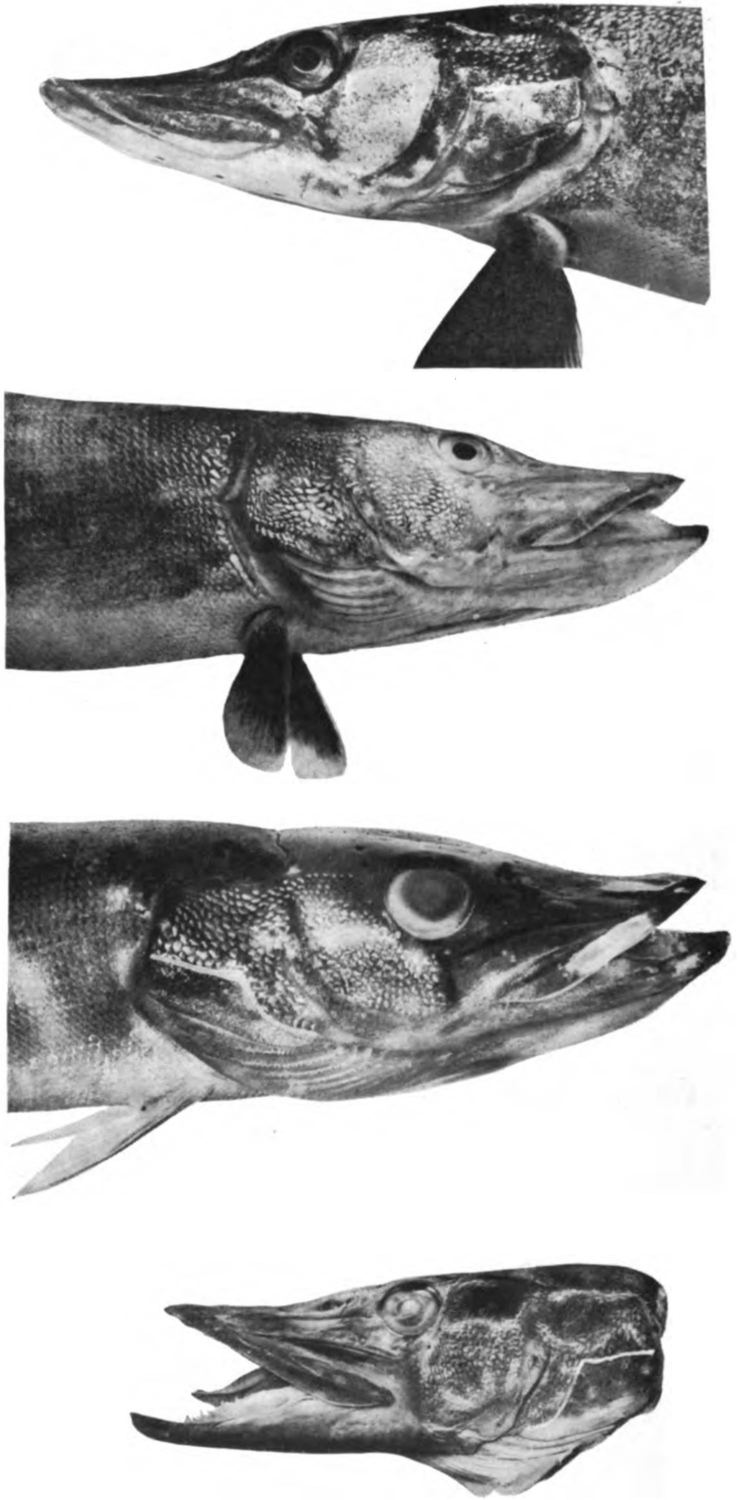
SPAWNING PICKEREL CROSS MALE PIKE'S PATH

Pike and pickerel are practically identical in their spawning behavior. This may be described briefly as follows: A female accompanied by one or more males swims about in a meandering path. Eggs and milt are cast during widely varying intervals, and at each emission violent lashings of tails tend to distribute both eggs and milt over a comparatively large area. Spawning pickerel have been observed crossing the paths of spawning pike. Should this occur at the proper moment, it is conceivable that a few eggs of one form might come into the area clouded with milt of the other and an accidental cross impregnation take place. No direct matings of pike with pickerel have been observed.

On March 30, 1917, the eggs from a 30.5 cm. pickerel having typical characters were artificially pressed into a moistened pan and covered with milt from a male pike likewise typical of its species. The reciprocal cross was not attempted. About 70% of these eggs developed normally, and those not preserved for future study, hatched in from six to ten days. A few of the young were reared in an aquarium to lengths varying from 3.8 cm. to 6.4 cm. after which they were transferred to a small newly made artificial pond of stagnant water. When six months old three specimens were captured and gave lengths of 15.2, 13.8, and 9.1 cm., respectively.

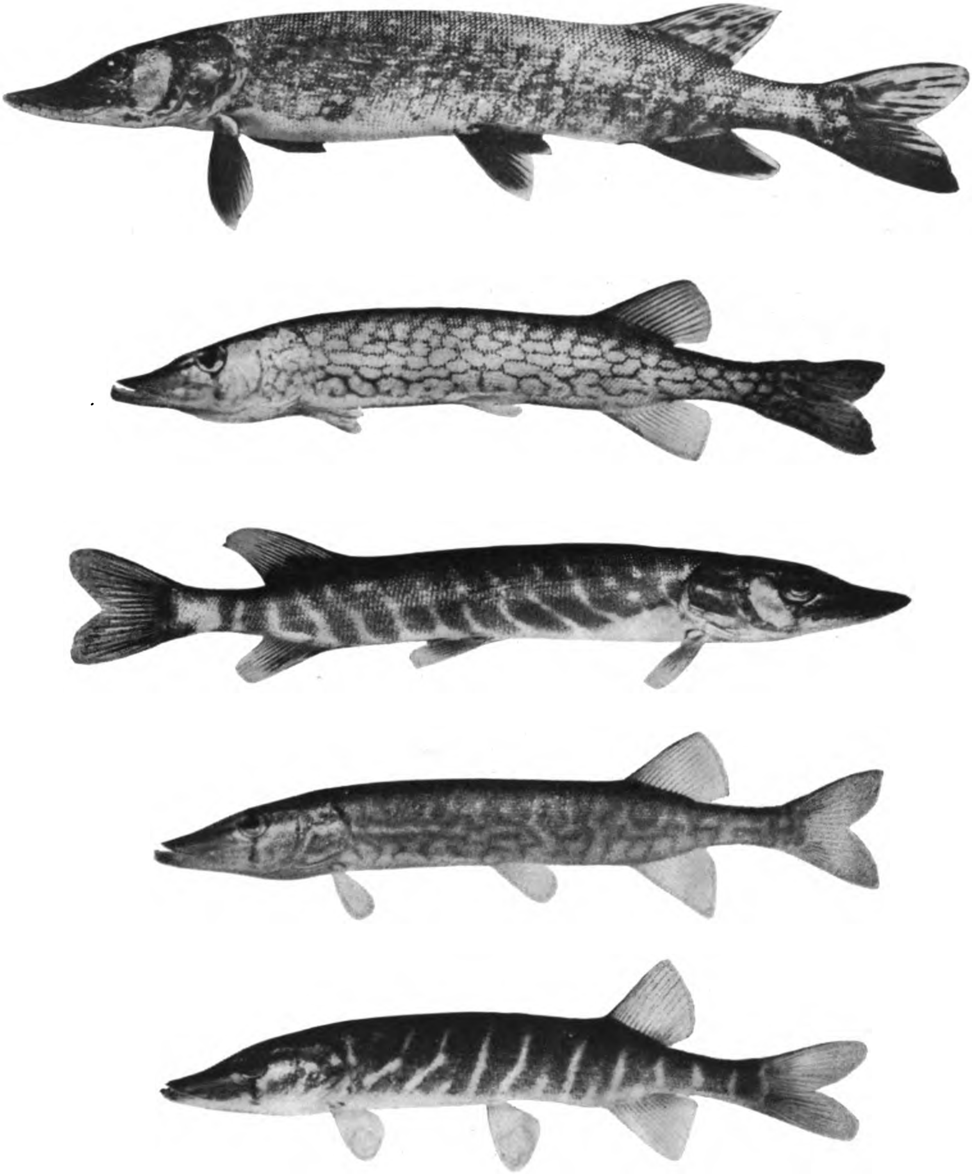
RECOGNITION CHARACTERS OF PIKE AND PICKEREL

The more obvious external differences between the pike and pickerel are found in the scalation of the opercula and the body color pattern. The extent of the scale covering of the opercula ["gill plates"] has long been considered the best character for the identi-



HEADS OF PIKE, PICKEREL AND HYBRIDS

Head of adult pike at top. Extent of scale covering on operculum [gill covering] indicated by white line. Head of adult pickerel, operculum fully scaled. Head of artificially produced hybrid. At bottom, head of supposed hybrid, captured in Cayuga Lake. White line indicates extent to which scales cover the operculum. (Fig. 4, a, b, c, d.)



PARENTS AND HYBRID OF PIKE X PICKEREL CROSS

Adult pike and adult pickerel shown at top; young pike, about seven months old, and young pickerel, about nine months old, in center. At bottom, artificially produced pike X pickerel hybrid, eight months old. (Fig. 5, a, b, c, d, e.)

fication of the two species. The color pattern may vary with the age, and with the particular body of water in which the fish lives. In Cayuga Lake, however, the color pattern of adults seems to be well defined and sufficiently constant to permit of identification by this character alone.

SCALATION OF CHEEKS AND OPERCULA

The head of a typical pike is illustrated in Fig. 4. It will be noticed that the scales extend all the way down on the cheeks and but half way down on the opercula. On the typical pickerel, Fig. 4,b, both the cheeks and opercula are entirely covered with scales. The three artificially produced hybrids, represented by Fig. 4, c, and the supposed natural hybrid, Fig. 4, d, are nearly identical in so far as the scalation of the head is concerned. About one-third of the lower half of the operculum is scaled while the other two-thirds is bare or has only one or two isolated scales. The hybrids are thus intermediate between the pike and pickerel with respect to this character.

COLOR PATTERN

The color patterns of the adult pike, Fig. 5, and of a supposed natural hybrid of mature size (45 cm. long) are blotches distributed over a darker ground color. In the case of the adult pickerel, Fig. 5, b, the pattern consists of an irregular network of dark lines inclosing a light ground color.

The artificially produced hybrids have not yet reached the age when the adult color pattern appears, but it is possible to compare the juvenile pattern of the pike, pickerel, and hybrid, Figs. 5, c, d, e. The pike and the hybrid resemble each other very closely, the diagonal light bars with broad and darker areas between them being very distinct in both forms. In the case of the juvenile pickerel, the distribution of color is quite different. Instead of distinct oblique bars of light color we have rather indistinct bars and scrolls running in various directions. In the region below the lateral line, there is a tendency to form narrow, dark bars with a broader and lighter area between. How constant this pattern is in the case of the pickerel, is not known, but it is not believed to be variable enough to interfere with the recognition of young pickerel in the presence of young pike. Since the adult pike and the supposed natural hybrid closely resemble each other in color pattern, and since a similar condition obtains between the juvenile pike and the artificially produced hybrid, there is some probability that the mature artificial hybrid will also resemble closely in color pattern the natural hybrid.

SUMMARY OF FINDINGS

Let us summarize the facts in the case as follows:

The overlapping spawning time and the spawning behavior of the pike (*Esox lucius*) and the pickerel (*Esox reticulatus*) are such as to permit of the possibility of a natural cross.

The eggs of the pickerel may be artificially impregnated with the milt of the pike and may develop into healthy hybrids.

Artificially produced hybrids and supposed natural hybrids are identical in the scalation of the opercula, showing a condition intermediate between typical pickerel and pike.

Typical adult pike and supposed natural hybrids are identical in color pattern.

Juvenile pike and the artificial hybrids are identical in color patterns.

Thus there is a probability that mature artificial hybrids will resemble in color pattern the supposed natural hybrids.

These facts seem to favor the assumption that pike and pickerel occasionally cross in nature.

IS WAR NECESSARY?

War a Normal State—Cannot be Abolished by Appeal to Reason or to Sentiment —Problem One of Biology—Bearing of Recent Researches on It

PAUL POPENOE

"AS I reflected," says Major George W. Crile, of the Medical Reserve Corps, "upon the intensive application of man to war in cold, rain, and mud; in rivers, canals, and lakes; under ground, in the air, and under the sea; infected with vermin, covered with scabs, adding the stench of his own filthy body to that of his decomposing comrades; hairy, begrimed, bedraggled, yet with unflagging zeal striving eagerly to kill his fellows; and as I felt within myself the mystical urge of the sound of great cannon I realized that war is a normal state of man."

The history of the race has left its mark in every man and woman. Through millions of years mankind fought its way upward. Every individual had to fight to avoid becoming the food of some carnivorous beast. He had to fight against the forces of Nature. He had, further, to fight with his own fellows, to some extent, for food, shelter, and a mate. Any male who could not and would not fight when necessary had small chance of leaving any offspring. It is natural, then, that every human male should still have an inborn disposition to war that, once it has been aroused by the appropriate stimuli, "the impulse to war is stronger than the desire to live." As an organism, man is probably better organized to fight than to do anything else.

War being instinctive in its origin, being an expression of man's inherited nature, it cannot be reasoned out of existence. "If men's actions sprang from desires for what would in fact bring happiness," Bertrand Russell points out[1] in his notable book, *Why Men Fight*, "the purely rational arguments against war would long ago have put an end to it. What makes war difficult to suppress is that it springs from an impulse, rather than from a calculation of the advantages to be derived from war."

Militarists have long recognized this fact and made the most of it. The fighting instinct being the strongest that men possess, militarists think that it is utopian to talk of suppressing it. War is not only natural, but inevitable; the only rational course for a nation to pursue is to recognize this biological fact and prepare to meet war when it comes.

So far as the immediate future is concerned, this is certainly true. But it is the function of science to take a long look ahead, and without hindering the present preparation for war, it may well submit this very important instinct to as searching an analysis as possible.

SIMILARITY OF WAR AND PEACE

It is sometimes supposed that war and peace are distinct states, but as a fact peace is, for most people, simply war under a different guise, and the transition to war is merely the transition from indirect to direct combat. "Pursuing, escaping, and fighting, the brute adaptations, have been gradually modified during the rise of man, until now in the complicated machinery of modern life the human energy expended by the savage in pursuit and escape and fight is expended in the shop, in transporting commodities on land and sea, in

[1]Why Men Fight, by Bertrand Russell, sometime fellow and lecturer in Trinity College, Cambridge (Eng.). New York: The Century Co., 1917.

preparing armaments, and in pursuing the arts and sciences," says Major Crile, one of the most noted students of the emotions.[2]

"The most powerful activator of man today, therefore, is his fellow-man. He is at war with him in business, in education, in philosophy, in the fine arts, in the professions, in the pulpit, in politics, in winning mates! In all his waking hours and in his dreams he exerts himself against his fellows. The savage stalks or ambushes his enemy or his prey in direct personal effort and settles the issue by physical prowess; civilized man stalks, ambushes and attacks indirectly through the media of trade and commerce. The savage settled his issue in one physical bout; indirectly through the organized community man may hurl himself against his rivals with every atom of his strength for months and years, and though this civilized combat draws no blood and tears no tissue, nevertheless the indirect battle is waged to its finish in bankruptcy, want, suffering, broken health, and premature death.

"The leaders of political parties, of opposing churches, of industrial and commercial corporations, individuals in medicine, law, education, literature, art, music, sports, even in philanthropy daily wage these indirect, but no less destructive, contests. In the field or in the shop the individual exerts his strength directly against his task, so that indirectly the energy he thus expends yields in return food, clothing, and shelter and a modicum of pleasure for him and his family.

ALL LIFE A BATTLE

"Thus in civilized life man is hurling his energies either directly or indirectly against his environment, to the end that he may live and reproduce. From the simple laborer to the head of the greatest commercial, scientific, educational, or governmental organization, the transformation of energy is made in accordance with the same principle, by the same organs, and for the same reasons as the transformation of energy in uncivilized man or in the lower animals.

"In the selective struggle for existence the acquisition of food developed speed, power, cunning, and craft in all species, but as the food suitable for each species is different, each has developed special activities and special responses to hunger. Man labors long and hard to this end, and the possibility of want is one of his great sources of fear; but a critical analysis will show that there is no difference between the orderly struggle of men to supply their material needs and the brutish attacks of the carnivora upon their prey."

Striking confirmation of this is furnished by a study of the effects which emotions produce in man and other animals. Fear, as Dr. Crile has shown elsewhere,[3] operates to develop certain organs and inhibit others so that every particle of available energy is concentrated upon the fighting mechanism. The advantage that this power must have given to prehistoric man in his struggles against superior foes in a wild environment is apparent to anyone who will allow his imagination to revert to those days of supreme physical contest. And the fact that this operation of fear has not yet undergone any change, although the demands of civilized life are very different from those of a wild existence, is good evidence that man is really ill-adapted to a life of civilization. "In spite of the fact that by harnessing the forces of nature, and by social coördination, which reduces the number of motor reactions, man has progressed vastly in his methods of acquiring food and avoiding danger, his body still responds to threatened moral or financial disaster, as if the old need for physical contest remained. His heart beats wildly; his

[2]A Mechanistic View of War and Peace, by George W. Crile. New York: The Macmillan Co., 1915.

[3]Man—An Adaptive Mechanism, by George W. Crile. New York: The Macmillan Co., 1916. See also The Origin and Nature of the Emotions, by George W. Crile. Philadelphia: W. B. Saunders Co., 1915.

respirations are quickened; he trembles and turns cold; his knees shake; beads of sweat stand upon his brow; he is pale and his mouth dry; he feels faint and may collapse. Whether the cause of fear be moral, social, financial, or intellectual, the result is the same. There is not one form of fear for the defaulting bank president and another for the hunter facing his first big game; not one group of fear phenomena for a mother anxious for her sick child, another for a friend waiting for news from the battlefield, and still another for the soldier facing a superior foe. In every case it is the same fear—fear of bodily harm—expressed in terms of bodily activation, and involving every organ and tissue, which would be involved were the natural phylogenetic response of flight from an enemy consummated in muscular exertion."

WHY MAN FIGHTS MAN

Much evidence might be given, but for the biologist it is not necessary. He recognizes clearly that man, as an animal, still possesses the strongly developed impulse to fight, which all other mammals have under certain conditions. The principal difference is this—that most animals fight primarily against the environment (including by that term all other animals), rather than against members of their own species. Man, however, long ago got the best of his environment, and the struggle against it has not for thousands of years called for much active physical combat. But the disposition for physical combat being still active, it has to find expression—partly in sports, partly in constructive work, and partly in fighting other members of his own species, to an extent which probably no other animal shows.

The impulse to war, then, is not only deeply ingrained in man's inherent nature, but it is far more complex and firmly entrenched than is generally suspected. It is not surprising that many persons have considered war not only natural but inevitable. Whether or not it is inevitable will be discussed in a moment.

Even if war could be abolished, it is often said it ought not to be, because it is of great value to the race (1) as an instrument of natural selection, and (2) as a source of national energy and racial well-being, as a prevention of decadence and effeteness.

1. The argument that war is beneficial because it allows the fittest to survive has been thoroughly debated in recent years, as a consequence of its espousal by German militaristic philosophers. It is now almost universally known to be fallacious. So far as the physical traits of the individuals of a belligerent nation are concerned, nearly everyone now realizes the strength of the eugenic argument: that, on the whole, war makes for the survival of the unfit rather than of the fit, since those who go to the firing line in a modern war are, on the average, physically superior to those who stay at home.[4] So far as mental traits are concerned, war played a more useful part in the evolution of civilization, up to within a very recent time; for so long as wars were fought by professional soldiers, the institution of war acted as a means of selection to eliminate from the population those who could not conform to the relatively peaceful, industrious, coöperative life which modern society requires. From this point of view, the evolution of society has been made possible by constant warfare, which killed off those in whom the predatory instinct was strongest. But about a century ago, when universal military service was introduced in Prussia and France, this selective effort of evolution ceased and war became, on the whole, as injurious to the race mentally as it has long been physically.

Modern warfare, then, cannot be alleged to be eugenic—to favor selective breeding. On the whole, it has a very injurious influence on national eugenics.

2. The argument that war ought not to be abolished even if it could be; that

[4]See Natural Selection in War, by Roswell H. Johnson. JOURNAL OF HEREDITY, vol. vi., pp. 546-548, December, 1915.

it is a necessary source of national energy; that it is a source of racial well-being, and that peace is inconsistent with a good life for men, is also fairly familiar. While it appears to be repugnant to most Americans, it contains some real stuff. Professor Russell gives a good statement of the case:

"A great many of the impulses which now lead nations to go to war are in themselves essential to any vigorous or progressive life. Without imagination and love of adventure a society soon becomes stagnant and begins to decay. Conflict, provided it is not destructive and brutal, is necessary in order to stimulate men's activities, and to secure the victory of what is living over what is dead or merely traditional. The wish for the triumph of one's own cause, the sense of solidarity with large bodies of men, are not things which a wise man will wish to destroy. It is only the outcome in death and destruction and hatred that is evil. The problem is to keep these impulses, without making war the outlet for them."

How strong these dispositions are can be known from the satisfaction which ensues when they are properly gratified—a satisfaction to which almost every soldier bears witness. "Men say that the wonderful thing about the terrible existence at the front is the sense it gives them of being intensely alive," writes a newspaper correspondent who interviewed many *poilus* in Paris. "Power, energy, endurance they have never imagined comes into their experience. They have a sense of vitality, a keenness never felt in ordinary life." And the experience of a charge is graphically described in *The Forum* by a former English clerk as "by all odds the finest feeling I ever had in my life."

"You can take it from me," he assures his correspondent, "that the most highly colored chromo-lithograph couldn't overdo it, the essential spirit of the thing. Their detail is pretty groggy, of course. No waving plumes, gay colors, flashing swords and polished top-boots. My goodness, no! We were all the color of the foul clay we'd come from—all over. But the spirit of it! It is perfectly hopeless for me to try to tell you, especially in a letter. They say they pump spirits and drugs into the Boches before they leave their trenches. No drug and no champagne, even of the choicest, could have given us any more exhilaration than one felt in that dash from the craters to the first Boche line. Heavens, but it was the real thing! Made one feel you'd never been really and fully alive till then."

EMOTION REQUIRES OUTLET

That is the sort of innate disposition for war which the biological student must face. Given that man has such inherited impulses, what is he to do with them? Any disposition that is baulked, that fails to find expression, sets up a nervous tension and leads to a degenerate condition, if not to a neurotic one.[5] Man has the fighting disposition, and as a matter of mental hygiene he must do something to "get it out of his system." What is he to do? Sport and business offer a measure of relief, as was pointed out above, but it is evident that they fail to be wholly satisfactory. The problem of science is to find a satisfactory substitute for war; to furnish men with the combat which their systems crave, but to make this combat productive instead of destructive. No amount of appeal to the reason or the emotions will abolish war, but the provision of a proper substitute for war might help to do so.

William James pointed this out clearly in his famous essay[6] on "The Moral Equivalent of War," and marked the path along which those must proceed who want to see the advantages of warfare retained and its highly dysgenic features left out. He suggested a universal conscription of youth, not for military training, but for a fight with the environment in the old, prehistoric way, in reclamation projects, for ex-

[5] This point is well made by Graham Wallas in The Great Society, Chap. ix. New York: The Macmillan Co., 1914.

[6] It was first delivered as an address before a meeting of pacifists during the Spanish-American War, and is printed in a volume on his collected essays.

ample. A year of this, not wholly devoid of hardship, ought to put iron into the soul of a young man, and conversely, take the fight out of him. At the same time, the stimuli to war must be reduced by a more rational system of education, which will show the horrors as well as the glamor of war, and will give more time to Pasteur and Darwin than it does to Napoleon and Marlborough.

SCIENTIFIC RESEARCH NEEDED

Much research will be required before the question of dealing with this instinct can be fully settled, but several men of science have given attention to it, since William James blazed the way, and have made suggestions that deserve consideration. Major Crile, as described above, points out that many of the activities of normal life give vent to the bellicose disposition. If the most satisfactory of these are extended and intensified, they would still further meet the need of human nature.

Captain Cannon, whose researches on the emotions are already classic, points out[7] that modern warfare no longer satisfies the emotional nature of man as it once did. The exhilaration of a charge across No Man's Land is undeniable; but charges nowadays are few and far between, and most of warfare is of a routine, mechanical nature. War as a psychological instrument for giving "tone" to a nation has been developed too far, he says, and something else is now required. From the physical point of view, he thinks greater extension of competitive athletics would be valuable, and he cites the case of the Igorrot head-hunters of the Philippines, who were turned from the warpath by the Americans and now find an outlet for their energies in sports. From the moral point of view, he thinks the fighting spirit of men should rather be turned against the environment. The great battle should be against pain, disease, poverty and sin, and international warfare of the present kind should rather be regarded as dissension in the ranks.

Professor Russell's discussion of the substitutes for war has been more thoroughgoing than that of anyone else. The first thought that naturally occurs, he says, "is that it would be well if men were more under the dominion of reason. . . . If impulses were more controlled, if thought were less dominated by passion, men would guard their minds against the approaches of war fever, and disputes would be adjusted amicably. This is true, but it is not by itself sufficient. It is only those in whom the desire to think truly is itself a passion who will find this desire adequate to control the passions of war. Only passion can control passion, and only a contrary impulse or desire can check impulse. Reason, as it is preached by traditional moralists, is too negative, too little living, to make a good life. It is not by reason alone that wars can be prevented, but by a positive life of impulses and passions antagonistic to those that lead to war. It is the life of impulse that needs to be changed, not only the life of conscious thought."

REDIRECTION OF IMPULSES

"Blind impulses sometimes leads to destruction and death," he points out again, "but at other times they lead to the best things the world contains. Blind impulse is the source of war, but it is also the source of science, and art, and love. It is not the weakening of impulse that is to be desired, but the direction of impulse toward life and growth rather than toward death and decay."

"There are three forces on the side of life which require no exceptional mental endowment, which are not very rare at present, and might be very common under better social institutions. They are love, the instinct of constructiveness, and the joy of life." All three of these, he thinks, are checked and enfeebled by the present organization of society, and such social reorganization as will give them freer play will help to make war unnecessary. Professor

[7]Bodily Changes in Pain, Hunger, Fear and Rage, by W. B. Cannon. New York: D. Appleton & Co., 1915.

Russell's book is devoted mainly to a discussion of how the necessary changes might be brought about. State power, private property, education, marriage and religion all receive a searching criticism. One of the factors which he thinks most helpful is political conflict. "Conflicts of party politics, conflicts between capital and labor, and generally all those conflicts of principle which do not involve war, serve many useful purposes, and do very little harm. They increase men's interest in public affairs, they afford a comparatively innocent outlet for the love of contest, and they help to alter laws and institutions, when changing conditions or greater knowledge create the wish for an alteration. Everything that intensifies political life tends to bring about a peaceful interest of the same kind as the interest which leads to desire for war."

NO SINGLE PANACEA

The biologist will not, of course, make the mistake of thinking that there is any one panacea which will abolish war. Neither universal democracy nor an omnipotent League to Enforce Peace will suffice by itself, although both these developments would be highly desirable. The means for reducing the number of wars in the future may be divided in two classes. First, there must be a reduction in the number and intensity of the stimuli which now stir up the war impulse; this requires changed methods in teaching history and patriotism, and doubtless numerous changes in the organization of society. Second, there must be attempts to guide the impulse to war into productive channels. Universal conscription, as William James suggested, would not only aid largely in this, but would also give the nation an immense army of vigorous young men, to be called upon at any time when the backward state of civilization in other nations made it impossible for this nation to avoid going to war.

There is no hope of an early abolition of war. There is no hope of ever abolishing it by appeals to reason or sentiment. But by the progress of scientific research, and the application of the knowledge thus gained, much can be done, if it is always borne in mind that the problem is one of biology and to be solved only by biological methods which take account of the fact that war *is* a normal state of man.

Wanted, Photographs of Twins

The American Genetic Association desires to communicate with twins living in any part of the world. It has been discovered that twins are in a peculiar position to help in the elucidation of certain problems of heredity. Good photographs at all ages are especially desired in order to determine the degree of resemblance and its persistence through life. Any information, giving the addresses of twins, who are willing to cooperate with the Association will be keenly appreciated.

It is known that there are two sorts of twins. (1) The true or "IDENTICAL" twins are developed from a single original egg cell which at some very early stage divided to form two individual beings. These "identical" or "duplicate" twins have a nearly (though never an absolutely) identical germ plasm, are always of the same sex and resemble each other to an extraordinary degree. (2) The other kind, "FRATERNAL" twins are no more alike than brothers and sisters born at different times. They are developed from two separate egg cells.

It is fortunate for our knowledge of heredity that there are these two kinds of twins, on account of the chance it gives to study the relative importance of the influence of heredity and of environment.

It is for the study of this fundamental question of the degree of influence exerted by environment as compared with that due to heredity that the cooperation of the twins of the world is solicited and any publicity given to this notice by the press will be of great assistance.

All Communications should be directed to the American Genetic Association, Washington, D. C.

HYBRIDS OF THE LIVE OAK AND OVERCUP OAK

Even the Forest Trees Hybridize and the Forestry of the Fut:re May Have to Take This Fact into Consideration

H. Ness

Horticulturist, Texas State Experiment Station

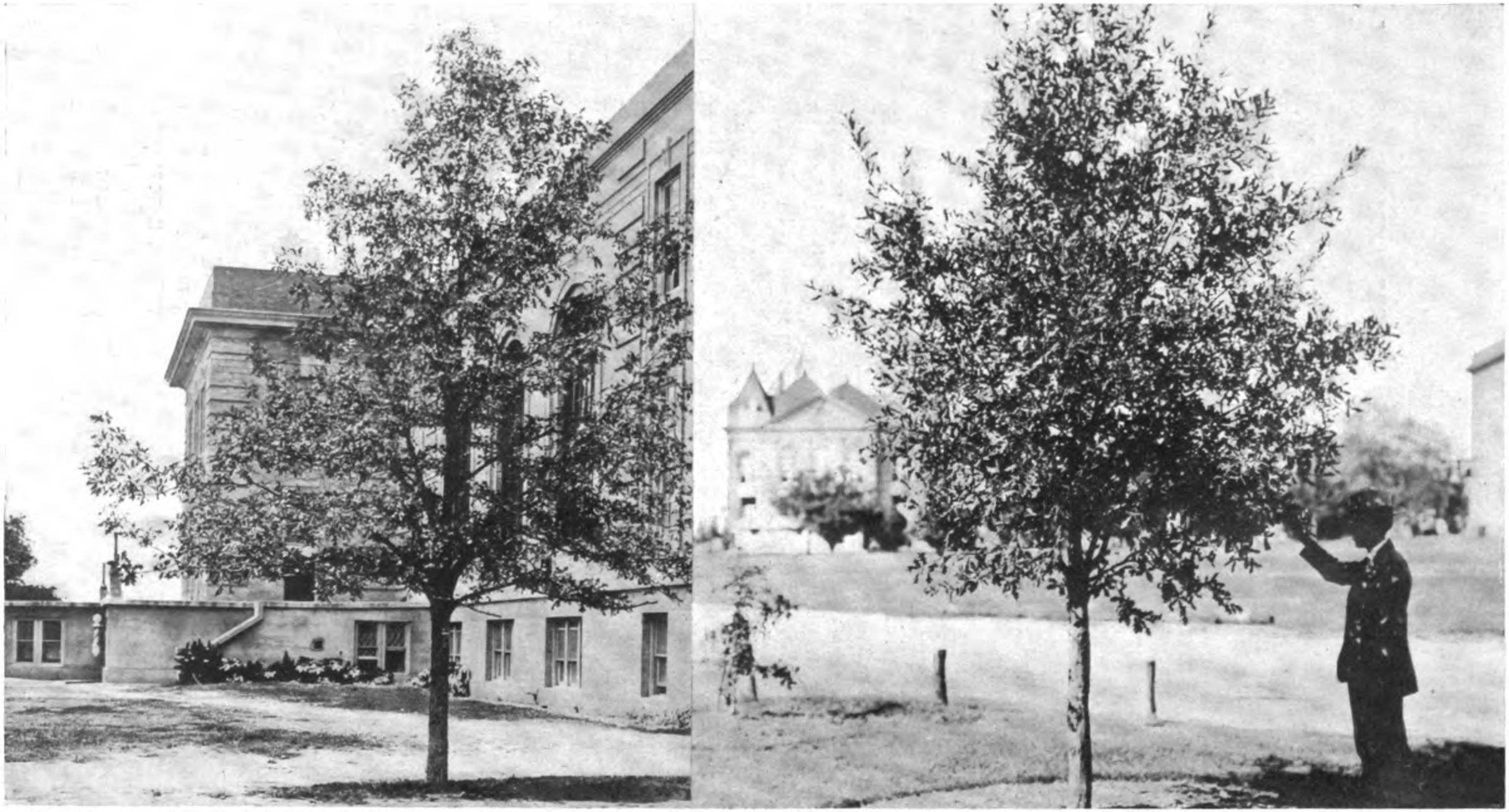
IT IS a fact, long known to botanists, that the systematic assignment of several species of our American oaks presents difficulties and doubts, because of variations that seem to confuse the characters of some of the neighboring species. It is also well known that several natural hybrids occur among the oaks—the number of which would certainly be greatly increased, if their characters merged less with those of one or the other of the parent species.

In a little hybridizing work, which I carried on with the Overcup Oak (*Q. lyrata*) as father and the Live Oak (*Q. Virginiana*) as mother, I have become impressed with the ease with which fertile hybrids may arise between species of oaks, even though the relationship be apparently quite distant. These two species agree in ripening their acorns in one season, hence belong to the same subdivision of the genus, which is called Lepidobalanus. But there is still a strong systematic difference, since they belong to the opposite extremes of that group of species.

They differ widely in habit of growth, in which Live Oak is characterized by its low trunk and a broad, diffuse head of rather crooked limbs and shoots; while the Overcup Oak is of a tall, pyramidal form with straight branches and shoots. Its bark becomes strictly flaky, characteristic of the true white oak group, while in the Live Oak it becomes rough and divided by fissures into numerous narrow and irregular ridges. The foliage of the Live Oak persists throughout the winter until the succeeding spring, while the Overcup Oak is one of the first to shed its leaves in the fall. The texture of the foliage in the Live Oak is strictly coriaceous; the form of the leaves vary from oblong to elliptical with entire or very remotely repand margins. In the Overcup Oak the leaves are four to five times larger than in the Live Oak and more papery texture, with deeply lyrately lobed in margins. But the greatest differences lie in the acorns and the cupules. In the Overcup Oak, the acorn is oblate and nearly covered by the cup, the scales of which are much thickened on the back. In the Live Oak the acorn is ovate, projecting about two-thirds of its length beyond that of the cupule, and the scales are thin, with membranaceous tips and margins.

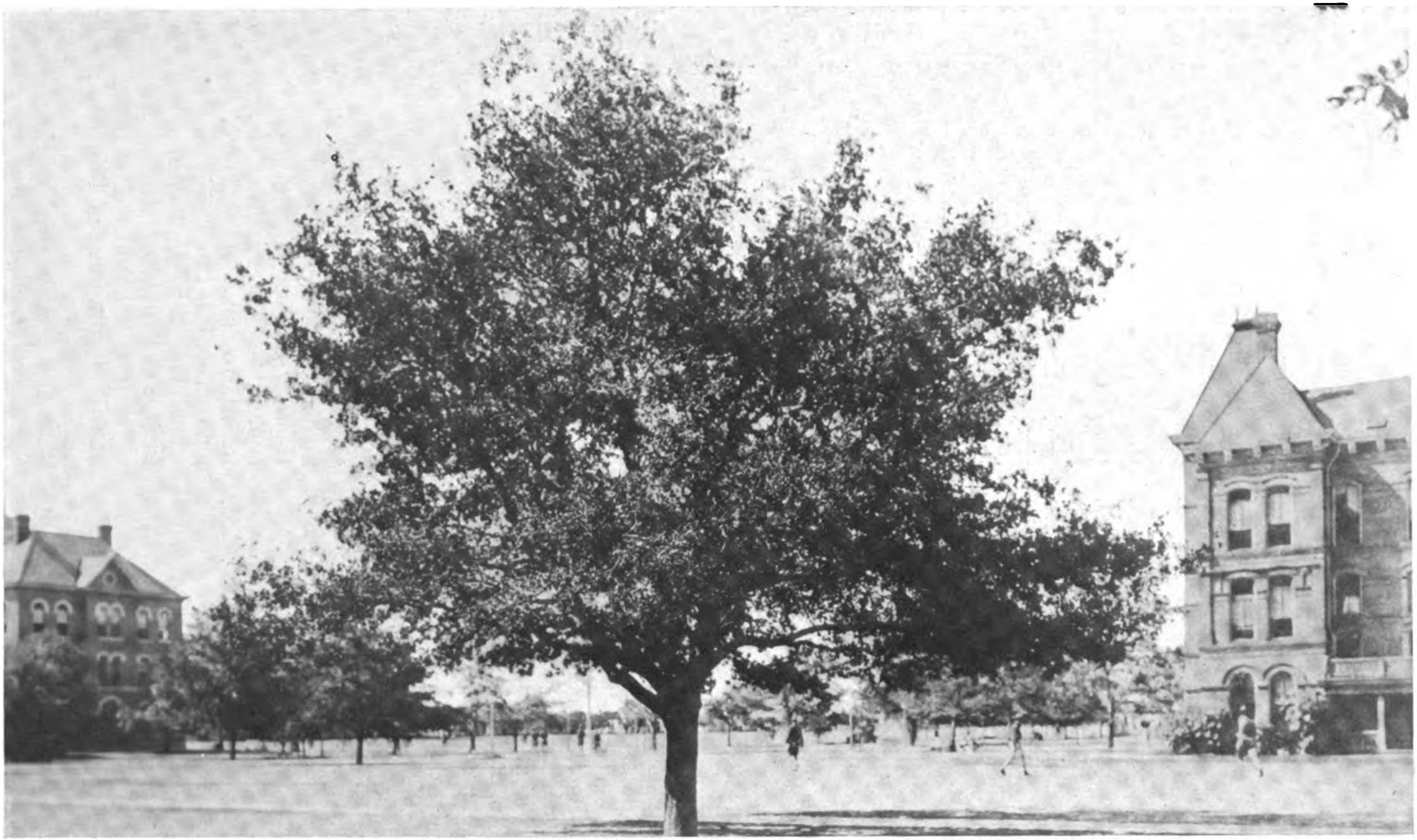
Cross pollination for my first hybrids took place April 6, 1909, after all male flowers on the mother trees and other soak in their vicinity had withered—hence no danger of interference with the cross-pollination. From this cross-pollination nine acorns, of which three were less than normal size, were obtained. The seeds were planted in pots November 9 and gave rise to three young hybrid oaks which were reared in the nursery until March, 1912, when they were planted where they could receive the best care and observation. These trees are, at the present writing, August 28, 1917, about 16 feet tall and with a trunk diameter of about 5 inches, 1 foot from the ground.

On April 14, 1910, a new set of cross-pollinations were made, trees of the same species being again mated in the same order. The result of this is three very vigorous specimens, planted on the laws of the Experiment Station building



ARTIFICIALLY PRODUCED HYBRID OAK AND ITS FATHER

Professor Sargent of the Arnold Arboretum described and named after Miss C. C. Compton of Natchez, Miss., a hybrid oak which she has found in the forest. Mr. H. Ness of College Station, Texas, has by artificial pollenation produced the above hybrid tree which is strikingly similar to the natural hybrid. The tree shown on the left is the male parent (*Quercus lyrata*). As an ornamental this hybrid (shown on right) is much superior to either parent because of the density and luster of its foliage. Its wood is hard, close grained and tough. (Fig. 6.)



THE LIVE OAK MOTHER OF THE HYBRID

The speed of growth of the Live oak (*Quercus virginiana*) is such that before the hybridizer who successfully crosses it with some other species can really judge of the success of his work his life is gone. He has the pleasure of seeing the young tree grow, and even of sitting in its shade but of its longevity, its ultimate size and its usefulness, others will probably be the judge. He is working for another generation. (Fig. 7.)

in March, 1913. These have during the present unfavorable season added an average of 3 or more feet to the length of every main limb. Of this second lot of hybrids there were originally planted four on the lawn of the Experiment Station building, the most vigorous and beautiful of which succumbed a year ago to the cottonroot rot, and a fifth was planted on the same ground as the first lot. Hence seven young hybrid oaks are growing on the campus, three planted in 1912 and four in 1913.

All these hybrid trees are so uniform in character that seedlings of pure parentage could not be more so. In all of them the father, or *Q. lyrata*, is easily dominant; especially is this true for the second lot, or those from the cross-pollination of 1910. Their pyramidal form and straight shoots are strictly characters of the father. The three of the first lot are less inclined to the pyramidal form of head, and show considerable proclivity to set short-jointed, more or less crooked, lateral branches, after the manner of the Live Oak. The leaves are very uniform in all of them, being intermediate in size of that of the parents. The general outline is oblanceolate with the margins dentately lobed. The texture is strictly cariaceous and of a color of a much deeper green on the upper surface than that of the father species. The leaves commence falling in the winter, but many of them remain green until spring. In the fruit, the Live Oak is strictly dominant except in the size, which is larger and may be considered intermediate. The bark, as it now appears on the lower part of the trunks of the older trees, will be flaky as in the Overcup Oak.

The wood, so far as I have cut into it in pruning, seems to be extremely hard, close-grained, and tough.

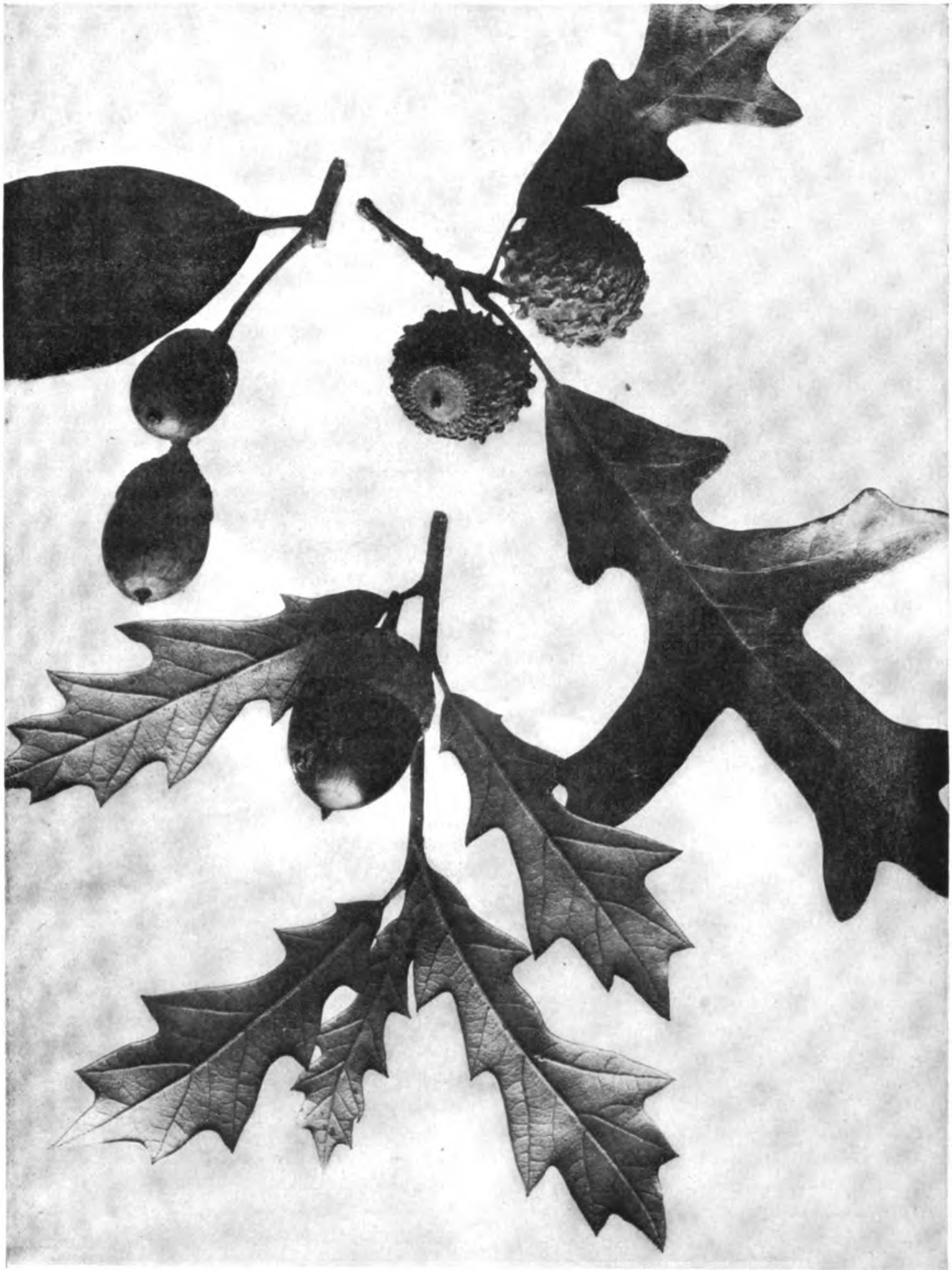
As ornamental trees, these hybrids are much superior to the mother, the Live Oak, in form, and to the father, the Overcup Oak, because of the density and luster of their foliage.

One of the three, planted in 1913 by the Experiment Station building, produced several female flowers in 1917, only four years after planting. One of these developed a normal acorn, although no male catkins were produced. The pollen that fertilized this female could possibly come from only two sources, namely, from a Post Oak (*Q. minor*) standing less than 100 feet to the south; or from a Water Oak (*Q. nigra*) standing about twice that distance to the southwest from the hybrid tree producing this acorn. Both of those oaks produced abundance of pollen during the time proper for fertilization of my hybrid oak.

The acorn was planted as soon as ripe, and has at the time of this writing developed into a little tree about 12 inches tall with twelve full grown leaves. The stem is more short-jointed than in any of the individuals of the immediate mother form. The leaves are of the same texture, have similar lobations, but are longer in proportion to the width than in those of the mother type. One or two of the larger of these leaves are strangely similar to the form of leaves frequently borne by strong water shoots upon *Q. nigra*. (I am bearing in mind that *Q. nigra* belongs to that group of oaks, which ripens its fruit in the second season after flowering, namely, the black oaks, or the red oak division of the genus.) My attempts to cross *Q. nigra* with *Q. Virginiana* have up to the present time been fruitless.

Since the above notes, made on August 24, 1917, a crop of twelve acorns from four mother plants have ripened, been planted, and at this time (June 14, 1918) made a growth varying from 6 to 14 inches in height. As to the immediate male parent of these, there is the same doubt as in the case of the first seedling of the second generation, referred to above. All of them are glabrous with the exceptions of one, which has pubescent stem and under surface of the leaves, strongly similar to a young seedling of a Post Oak. One has the lyrata-form of leaves to a very marked degree.

At the present writing, the form of the leaves seems to be in a state of transition, the later ones being somewhat different in form from the earlier. How-



ACORNS AND LEAVES OF THE HYBRID OAK AND ITS PARENTS

The small characteristic acorns and the entire unlobed leaf of the live oak is shown at the upper left. The Overcup Oak acorns with their nearly enclosing cups and much thickened scales, and the deeply lobed leaves, on the upper right. Below are the acorns and leaves of the hybrid which appear intermediate between those of its parents. They are dentately lobed, their texture is coriaceous and they are of a much deeper green than the father species. These leaves commence falling in the winter but many remain green until spring. (Fig. 8.)

ever, similarity to the first generation both in form and texture is a dominant feature, leaving the identification of the immediate male parent in obscurity.

At present a small crop of young acorns are in formation on some of the trees of the first generation; but as only three male catkins were observed on the most fertile of them, the pollen is again from a foreign source.

In this connection it is of considerable pleasure and interest to receive "Notes on North American Trees," just published in the *Botanical Gazette*, vol. lxv, No. 5, by Professor Sargent. In these notes he describes the natural hybrid *Q. lyrata Virginiana*, and names it *Quercus comptonae*, in honor of Miss C. C. Compton, of Natchez, who has assisted him in obtaining specimens of this hybrid from trees growing in her vicinity. Besides in Mississippi, Professor Sargent mentions localities in Louisiana, Alabama and Texas, where this natural hybrid has been found and comments on their great similarity to mine, due to artificial crossing.

Mentality of the Arriving Immigrant

After examining 296 immigrants by means of a series of mental tests, E. H. Mullan of the U. S. Public Health Service, reports that but three of them turned out to be positive cases of mental deficiency and had to be certified for deportation as such. Eight others were thought possible cases of mental deficiency but were not certified as such. Twelve immigrants who gave fair responses to test questions exhibited peculiarities which are suggestive of pathological mental states. These symptoms were not, however, taken into account in grading the subjects, as they were thought to belong more properly to the domain of psychiatry.

Those tested included 103 Italians, 50 Hebrews, 26 Russians, 26 Ruthenians, 25 Spaniards, 21 Germans, 11 Poles, 11 Greeks, 4 Norwegians, 3 Lithuanians, 3 West Indian Negroes, 2 Danes and eight of other nationalities. The tests were given through an interpreter and were not such as to allow a classification according to mental age to be easily made. Arithmetical, memory, transitional tests were given and nonarithmetical reasoning tests.

Subjects were scored by a point scale. It would seem that no general statistics have been drawn up for the entire group of either subjects or tests, and for this reason it is impossible to offer many generalizations regarding the findings.

Errata

Attention is called to the following errors in the article by Dr. Geo. F. Freeman in Vol. ix, No. 5, of the JOURNAL OF HEREDITY (May-June, 1918):

Page 213.—For Fig. 14 read Fig. 12, for Fig. 15 read Fig. 13, for Plate II read Fig. 13. (This error occurs in three places at the bottom of the page.)

Page 214.—For Plate III read Fig. 14. (This error occurs in 3 places.)

Page 215.—For (*b*) in legend read (*c*).

Page 217.—For Plate III read Fig. 14. (This error occurs in three places at the bottom of the page.)

Page 218.—Column two line, 29, for "tarch" read "starch."

Page 222.—For Fig. 16 read Fig. 14. (Two places.) For Fig. 17 read Fig. 15. (Two places.) For Fig. 18 read Fig. 16. (Two places.)

Dr. Wm. Trelease writes that Fig. 12 on page 407 of the JOURNAL OF HEREDITY, Vol. v, No. 9, is not *Quercus insignis*, but is *Q. cyclobalanoides* Trelease. This oak is a native of Chiapas, Mexico, not of Huatusco, as was stated. Dr. Trelease has illustrated these two species in his article on The Large Fruited American Oaks in The Proceedings of the American Philosophical Society, Vol. liv, No. 216, plate III, 1915.

WILL MORALITY DISAPPEAR?

Paul Popenoe

There is much evidence indicating that morality is dependent on heredity —that virtue can only develop with a certain inherited background. If this be true, then the amount of morality in the race will be largely dependent on the birth rate.

It is for obvious reasons difficult to find statistical material in which the parents can be graded according to their morality. Frederick Adams Woods was particularly successful in this respect, in his careful study of European royalty, where by averaging the estimates of historians he was able to form an unusually accurate estimate of the mentality and morality of the sovereigns and their relatives. When he classified the individuals in 10 groups, according to the amount of morality they possessed, he found that the number of children who reached 21 years was correlated with the morality of their parents. Those who were low in virtues had only 1.66 children each, while the moral geniuses at the top of the list brought 3.83 children each to maturity.

While this single investigation is not adequate proof of the correlation between morality and net fertility, yet the result is no more than one would expect. There are many reasons, both medical and economic, why the children of the more vicious and depraved *naturally* die in greater numbers; and if they do, then the evolution of a higher moral state has been brought about partly by selective breeding.

ROYALTY GOOD WORKING MATERIAL

Royal families furnished particularly good material to test the problem, because there has probably been no artificial restraint of the birth rate there; reasons of policy make monarchs desire to have as large families as possible.

If there were no interference with the course of evolution, if there were no restriction of families among the moral, and if no aid were given to the immoral in bringing up their families, it seems probable that moral people would steadily have the larger families, and the increase of moral qualities in the race would be ensured.

RESTRAINTS ON SELECTION

How is it nowadays, when every sort of interference with natural selection is found?

It is difficult, as was pointed out above, to find a population in which the individuals can be graded for statistical purposes; but we can easily find populations all of whom are, on the whole, superior in morality. Francis Galton made a study of famous divines, finding that "they are a moderately prolific race, rather under than above the average." This would seem to be explained by the fact that "they usually have wretched constitutions" College professors are probably as moral as ministers, however, and offer more material for study. If their racial contribution is considerably above or below the average, one can draw some inferences in regard to the amount of morality which the nation is likely to possess a few generations hence.

In the first place, there are large classes of them who are celibate. Such are, for the most part, the professors in the separate women's colleges; likewise the tutors and fellows in English universities.

A study of the past and present members of the faculty of the University of Illinois, as enumerated in the Alumni Record of 1913, has been made for the Journal of Heredity by W. L. Altman. The total number of individuals listed is 1,154, of whom 363 men and 123 women are single, that is, 42% of the total number. Many of these are young, however, and may marry later.

Of the remainder, there were 618

married men and 50 married women. The study was limited to those who had been married for at least 10 years, and whose families therefore should be nearly complete. This reduced the number to 387 men and 28 women.

The 387 men had altogether 806 children, or an average of 2.08 each. The 28 women has 26 children, or less than one apiece.

The latter figures perhaps indicate that children are much more of a handicap to a professional woman than they are to a professional man, since most of their care usually devolves upon the woman. More weight can be laid on the figures for the men; they confirm J. McKeen Cattell's researches, which showed that the two-child family is now practically standardized among American men of science.

A study made at the University of Wisconsin a few years ago showed, according to O. E. Baker, that the married members of that faculty had about 2.5 children each. This is a high figure for the professorial class, and is probably reached in very few universities.

It is scarcely necessary to point out that the two-child system is inadequate to ensure even the bare maintenance of a given section of the population. When a certain amount of premature mortality, and the failure of some to marry, are taken into account, it becomes evident that the group which limits itself to two children per family will steadily decline in numbers. If morality and intellectuality are, as we believe, due largely to heredity, then the amount of them in the population will become less each year.

SOME UNLIMITED FAMILIES

There has been no such diminution in the fertility of groups that are not conspicuous for morality. It was found (according to O. E. Baker) that feebleminded persons who applied for relief to the Associated Charities of Madison, Wis., had families of 6.2 children, on the average.

To cite but one more study on this side of the ledger, A. H. Estabrook finds in his study of the great "Juke" family, a clan of several thousand imbeciles, criminals and ne'er-do-wells, that the women who have children have on the average 4.3 apiece. This is about twice the number borne by the college professors' wives.

Now mere quantity of children is of little concern to the eugenist. If the Juke women and their like were bearing *no* children, we could be well satisfied with the average of two from the college professors. It is the *relative* birth rate that occupies the eugenist's attention, and he cannot help feeling alarm at such tendencies as these figures indicate.

Certainly the college professors are in many cases not to be criticised for their small families; they must rather be commended for refusing to bring into the world more children than they can properly care for. The fault is more that of society than that of the individual. If society does not want to see the amount of morality diminishing with each generation, it must take some steps to get a larger birth rate from such a class as that of the college professors, and it should also take whatever steps are possible to reduce the racial contributions of the germinally anti-social—at least such as are mentally defective. These two problems make up nearly the whole of national eugenics. A good start has been made on the second, but little or nothing has been done on the first, which is really the more important.

The solution of the first is not a matter to be settled by the geneticist, but rather by the economist and sociologist. The geneticist can only point out the problem and emphasize as much as possible the urgency of its solution. Unless economic and social changes permit and encourage people of superior morality and intelligence to have more children, eugenics can make little progress. For the class of people typified by the college professor, children are today a liability. It is the task of the statesmanship of the future to make them an asset.

INHERITED FEEDING HABIT OF HERONS

John T. Zimmer

Bureau of Agriculture, Manila, P. I.

RECENTLY I had the opportunity to observe a very curious habit possessed by two young herons, which was interesting from the standpoint of its possibly hereditary nature as well as for its peculiarity.

The birds belonged to the species *Pyrrherodia manilensis* (Meyen) and were kept in captivity by Alfred Worm of Manila. At the time in question they were being given their morning meal of partly dried fish, which were thrown to them on the floor of the verandah where the birds were kept. I noticed that they seemed to be having some little difficulty in securing the fish, and that they would peck at each one a number of times before finally obtaining it. Continued observation made it evident that the first efforts invariably fell short of the mark. The consistency of the mistakes in this particular suggested a clue to the explanation. Accordingly, to test out the theory, a few fish were thrown into a basin of water, where they sank to the bottom, and offered to the birds in that state. True to expectation, the herons unerringly picked these fish out of the water at the first attempt.

LIGHT REFRACTION CAUSE OF ERROR

The explanation which presented itself to me, is based on the refraction of light. The submerged fish appeared to the observers to be somewhat more distant than they actually were, and hence the herons, in order to reach the mark, were obliged to aim at a point appreciably nearer than the apparent position of the object. This they seemed to do as a matter of course. Since, in a wild state, they would secure most of their food from shallow water, food consisting for a large part of prey which would escape if not obtained at the first attempt, this habit of rectifying the aim, to correct for refraction would be extremely advantageous if not indispensable. In the present case, however, it seemed to be present at the expense of ability to align the stroke in the direction of actual sight or at least to recognize the necessity for such alignment.

UNABLE TO PROFIT BY EXPERIENCE

An interesting feature of the case was the apparent failure of the birds to profit fully by experience. Although they were able to find each object of search after a series of trials, at the next venture they reverted to their original, deflected aim. The persistence of this action leads me to believe that the habit is an inherited trait. I was told that the herons had been fed occasionally in water, since their capture some three weeks previously, but their rations had been given to them for the most part on the bare floor, and as they were taken from the nest when they were less than a week old, there is little chance that the performance was the result of experience, especially since experience seemed to have so little effect in overcoming the difficulty when circumstances demanded it. Whether or not the young herons will acquire greater proficiency in terrestrial feeding as they grow older, remains to be seen.

CHINA'S TREES AND OURS STRIKINGLY ALIKE

Three American Trees Have Their Only Non-American Relatives in China—Two Continents Probably Connected in Geologic Times—Isolation in Different Environments Has Not Produced Marked Changes in Trees

SEPARATED by eight thousand miles of ocean, and four thousand miles of land, the eastern part of North America and the forest areas of China present some striking resemblances in vegetation. Three species of forest trees which grow wild in both China and the United States, but nowhere else, are particularly noteworthy. They are the Tulip Poplar (*Liriodendron sp.*), the Sassafras (*Sassafras sp.*), and the Hickory (*Carya sp.*).

ONLY TWO TULIP POPLAR SPECIES

The American Tulip Poplar (*Liriodendron tulipifera*) is one of the most beautiful of native flowering trees, its clean growth and handsome flowers making it justly admired (Fig. 9). The flowers greatly resemble the tulip and the young growth is very similar to that of the poplar. It is often known as "whitewood" in the West. The flowers are borne on the young growth of the current season and are bell-shaped and upright, being of a greenish-yellow color, orange within the base, solitary and entirely odorless. The leaves are a bluish-green and are borne on long stems, adding much to the beauty of the tree.

Its entire appearance is similar to that of the Magnolia, and this is not to be wondered at, since both belong to the order Magnoliaceae. The tree is one of the fastest growing, tallest, and largest of any of the forest trees. In a contest held by this Association in 1915, a Tulip Poplar discovered by John R. Hess, of Providence, R. I., proved to be the tallest tree reported in this country. It was 198 feet in height, with a circumference 4 feet above the ground of 34 feet 6 inches.

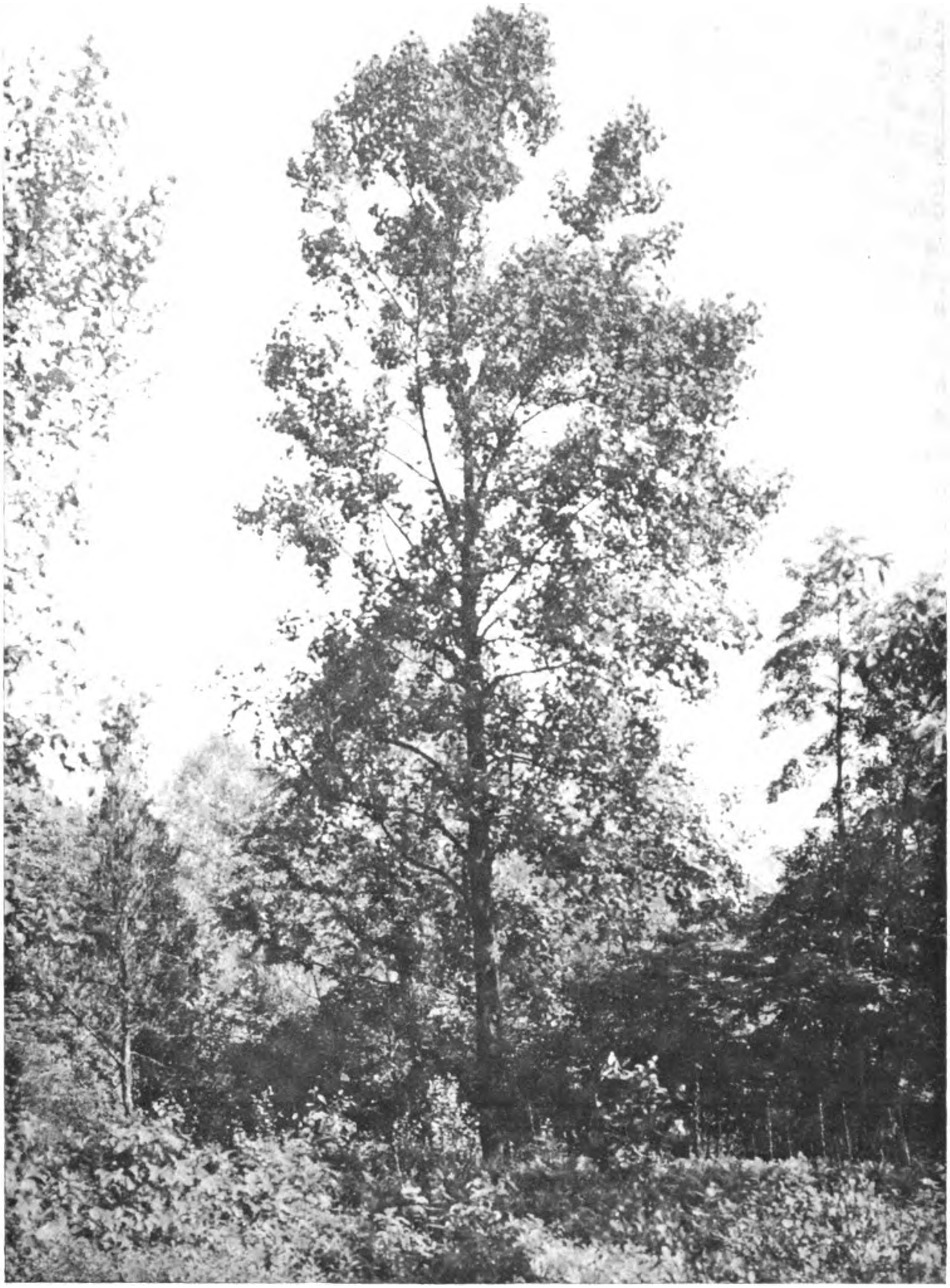
Of course, when the tree attains such an enormous height, it is almost impossible to see the flowers, and hence many of the young trees are headed when desired for ornamental purposes, thus being induced to keep a rounded outline and bear their flowers where they can be seen. The tree may be readily grown from seed.

The Chinese species, the only other of the genus (*L. chinensis*, Fig. 10), may well be called the Chinese counterpart of the American tree, for although it does not attain the immense height reached by the species in this country, the leaves are much the same shape, the flowers only a little smaller and the fruit somewhat elongate, the changes as a whole being trivial. It can be readily grafted on the American species. It grows rapidly when young, sometimes as much as 3 or 4 feet in one year. It is of vigorous constitution, and thrives best in good loamy soil.

ONLY TWO SASSAFRAS SPECIES

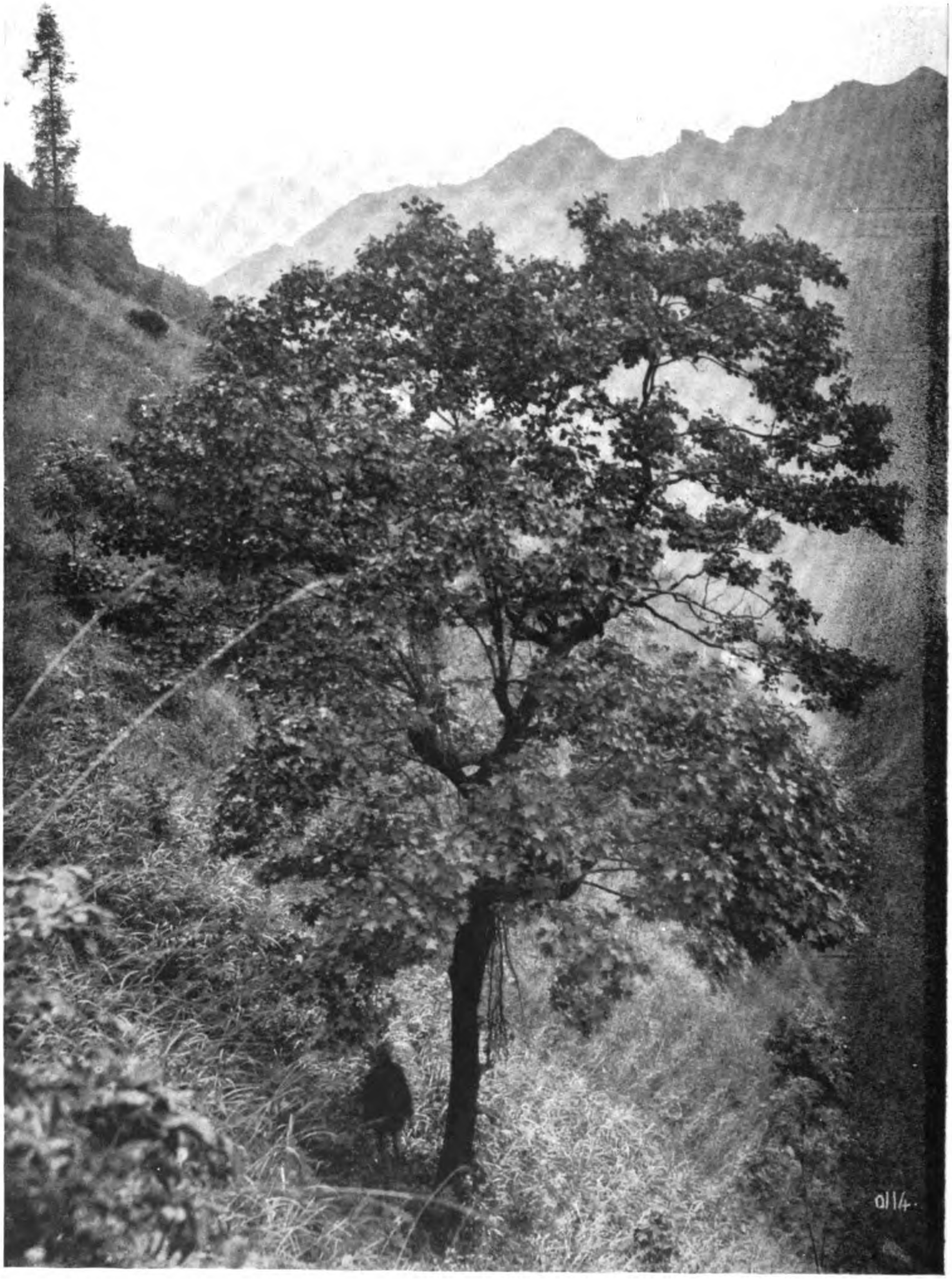
Due to its aromatic fragrance and the peculiarly piquant taste of leaves and bark, the Sassafras is a tree that is not soon forgotten by anyone who has ever made its acquaintance. A deciduous tree, the American species (*Sassafras sassafras*, Fig. 11) reaches a height of 50 to 70 feet, and a circumference of more than 14 feet was reported from Horsham, Pa., where the largest specimen in this country appears to exist.

The young shoots are sparsely downy at first, but later lose this characteristic. The flowers are greenish-yellow, produced in May, the sexes usually being on separate trees. The fruit is a dark blue, roundish oval, three-quarters of an inch long. The tree can withstand



THE AMERICAN TULIP TREE

One of the handsomest of American trees, the Tulip Tree (*Liriodendron tulipifera*), known in some parts of this country as Tulip Poplar or Whitewood, is of beautiful growth and produces flowers which make it justly admired. It is one of the fastest growing and tallest of forest trees and greatly resembles the Magnolia in general appearance. The flowers, which are borne on the young growth of the current season, are bell-shaped and upright, solitary and of a greenish-yellow color, orange within the base, and entirely odorless. The photograph was taken in Hamilton County, New York. (Fig. 9.)

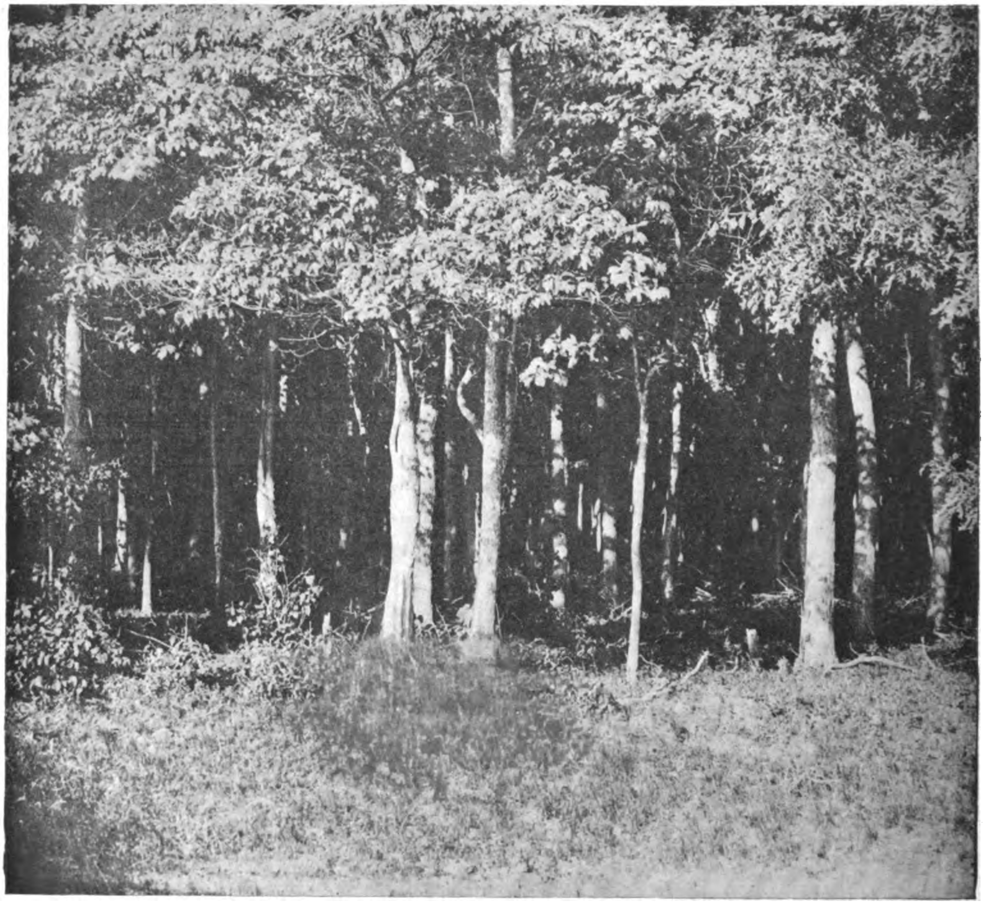


CHINESE COUNTERPART OF THE AMERICAN TULIP TREE

There are only two species of tulip tree known, one in Eastern North America, the other in Western China. Of vigorous constitution, the Chinese tulip tree (*Liriodendron chinensis*) is the Chinese counterpart of the North American tulip poplar or whitewood. It appears to thrive quite well when grafted on the American species, *L. tulipifera*, and differs only in the most minor characters from its American relative. Photograph from E. H. Wilson. (Fig. 10.)

CHINESE COUNTERPART OF THE AMERICAN SASSAFRAS

The Chinese Sassafras (*S. tzumu*) is the only other species of sassafras known besides the American. It reaches a height of 50 feet when growing wild and produces a timber which is much valued by the mountaineers of the region where it is found. Except for small differences, it is practically identical with the North American species. Photograph from E. H. Wilson. (Fig. 11.)



GROWTH OF AROMATIC SASSAFRAS

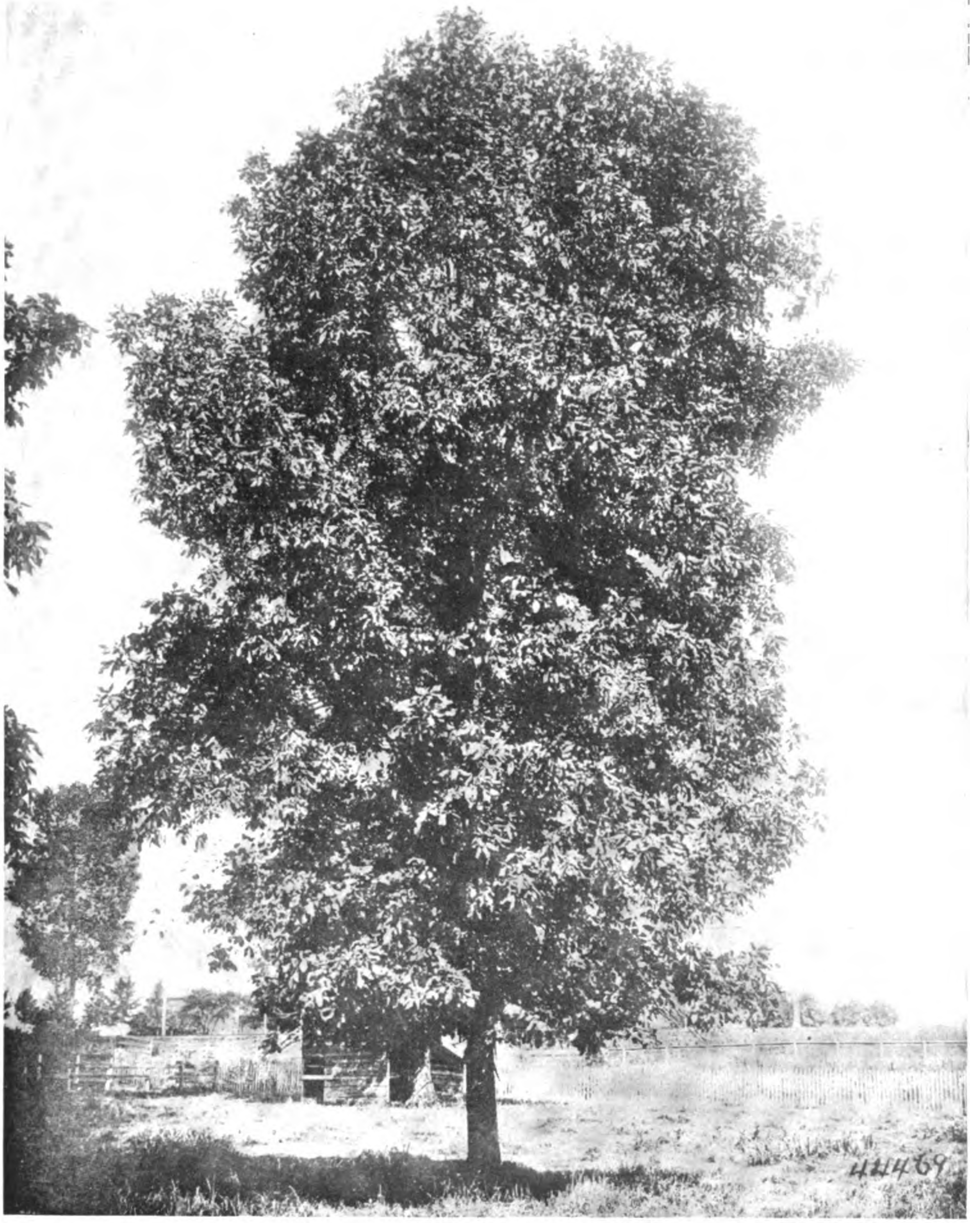
The aromatic and pungent fragrance of bark and leaves of this tree are well known. It reaches a height of 70 to 90 feet under favorable conditions. The young shoots are sparsely downy at first, but the heavier growth is covered with a rough bark. The fruit, which is a dark blue, roundish oval and about three-quarters of an inch long, is produced from greenish-yellow flowers which are borne in May, the sexes being on separate trees. Photograph by courtesy of U. S. Forest Service. (Fig. 12.)

severe frost, although when young the foliage is sometimes crippled. It prefers a warm, loamy soil, where it grows well.

The only other species of sassafras known, *S. tzumu* (Fig. 12), is found in many places in China. There are minor differences in the structure of the flower, and the young shoots and leaves are smooth. The leaves, with the principal veins, are reddish, and much of the young wood is purple-spotted. The Chinese species attains a height of 50 feet, and produces a timber which is highly prized by the mountaineers of the regions where it is found wild.

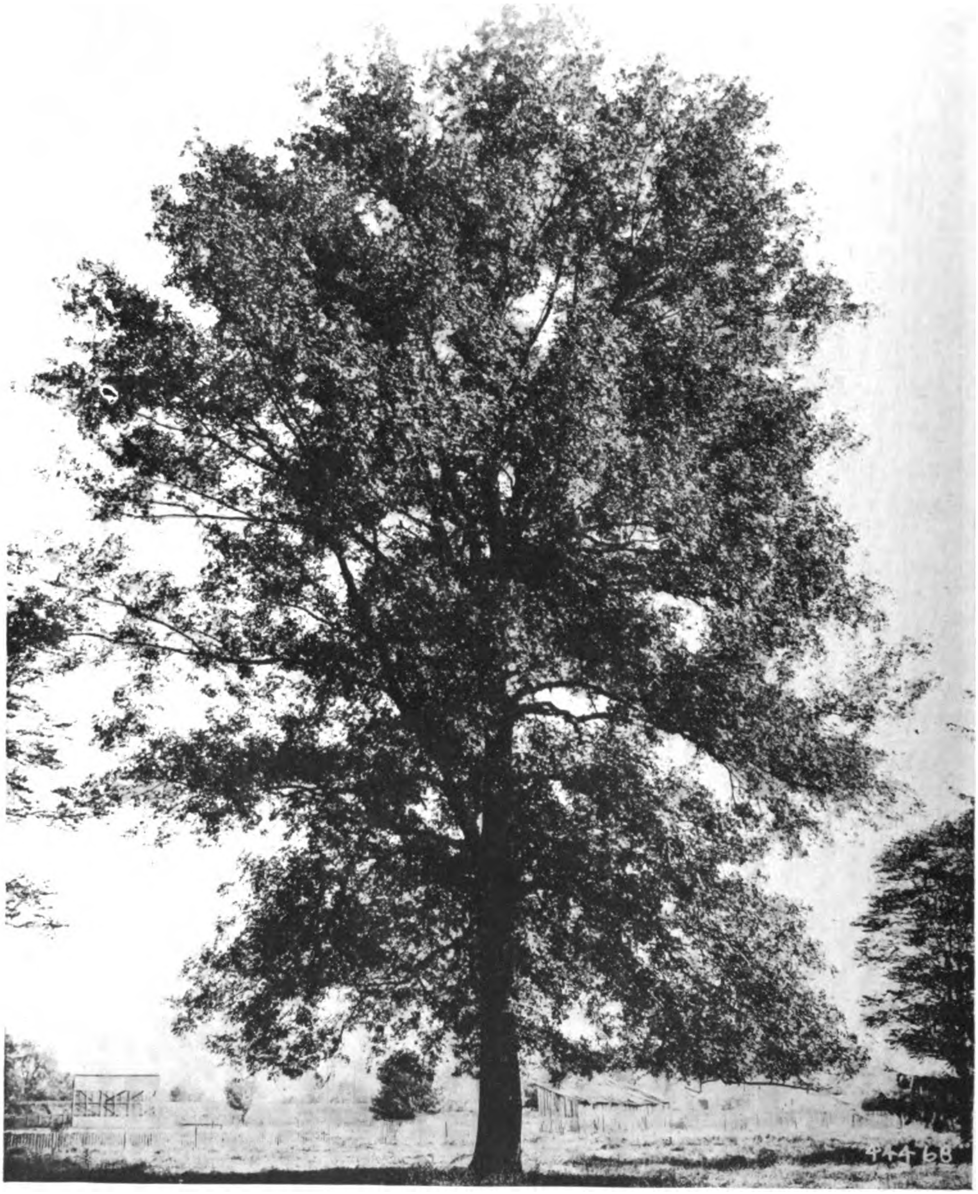
CHINESE HICKORY DISCOVERED

Up to a short time ago, it was believed that the Hickory (*Carya sp.*) was confined entirely to the United States, where a score of distinct species are found. A rumor of a supposed Hickory growing in China was traced some years ago to the Candle Nut tree, and it was not until the discovery of *Carya cathayensis* by the late Frank N. Meyer, of the office of Foreign Seed and Plant Introduction U. S. Department of Agri-



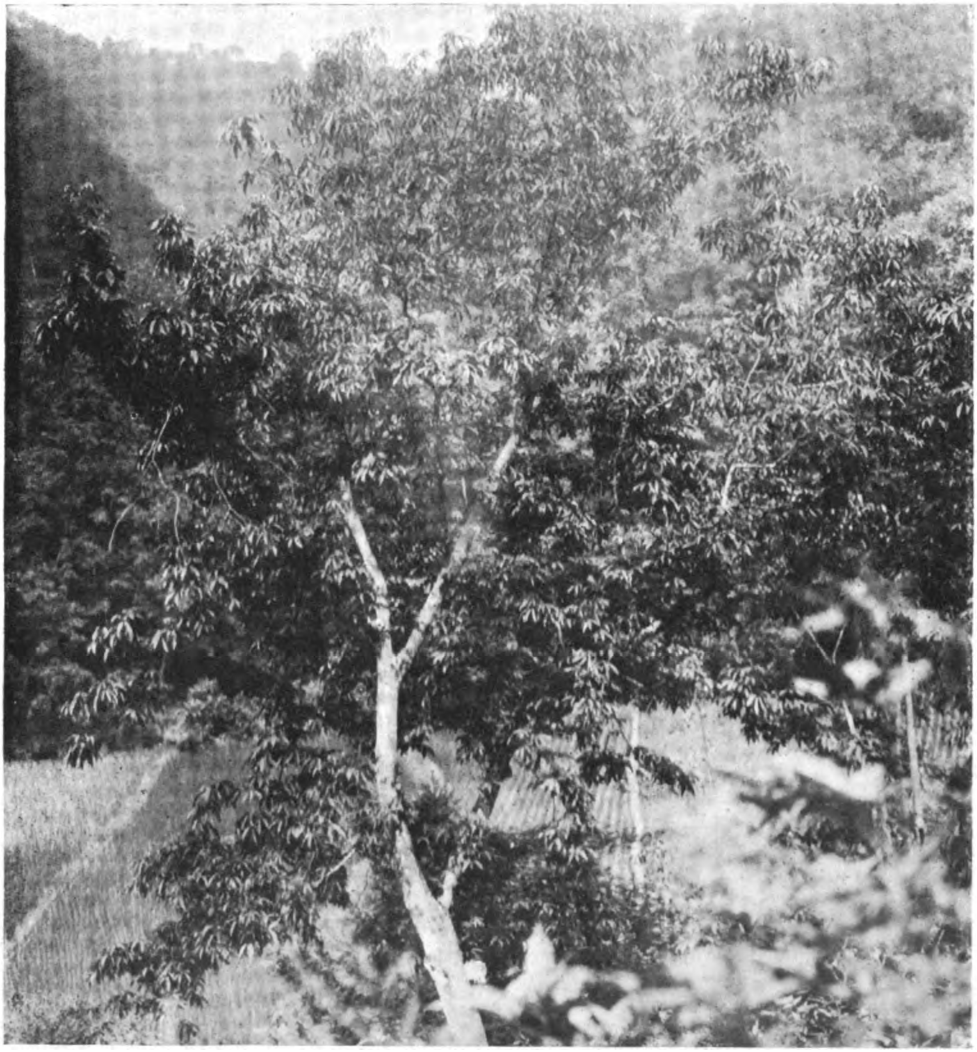
THE AMERICAN SHAGBARK HICKORY

This Shagbark (*C. ovata*), grown at Morenci, Michigan, is a good specimen of this type of tree, and has attained a height of more than 45 feet. The rather common oblong shape of the crown is very noticeable here, the outline of the tree being quite regular except for a few stray branches. As may be seen, the trunk is straighter and more slender than would be expected in a tree of such size. The name of the variety is suggestive of the roughness of the trunk. Photograph by courtesy of U. S. Forest service. (Fig. 13.)



THE AMERICAN BITTERNUT HICKORY

Of less compact growth than many other species, the Bitternut Hickory (*Carya cordiformis*) is perhaps all the more graceful. The name of the tree alone suggests the rather unpleasant quality of the nut, which, because of its flavor, is not so valuable as that of other species. The slender trunk may be seen rising almost to the top of the tree. This tree is growing at Morenci, Mich. Photograph by courtesy of U. S. Forest Service. (Fig. 14.)



THE CHINESE COUNTERPART OF AN AMERICAN HICKORY

It has always been assumed that no hickory trees were to be found outside of the United States until Meyer's discovery of the Chinese hickory (*Carya cathayensis*), near Hangchow. The tree pictured was a fruiting specimen growing at the base of a mountain. The bark is ashy grey with patches of white. This tree rarely attains a height of over 60 feet, and, at the age of 50 or 60 years, has passed its prime. Photograph by Frank N. Meyer, Foreign Seed and Plant Introduction, U. S. Department of Agriculture. (Fig. 15.)

culture, that a species of Carya was definitely located outside of the United States.

The American Hickory has been one of the most valuable of all our hard wood trees. It is hard to imgaine how our forefathers could have done what they did to develop their country without its wonderful timber. It is found wild throughout almost the entire eastern half of the country.

The Hickory is among the most beautiful and useful of American forest trees, and makes an exceptionally ornamental park tree, with its straight, generally high, and slender trunk. The leaves are light green, changing to yellow or orange and orange-yellow in the fall, and form a graceful head of foliage, generally pyramidal or oblong in shape. The wood is heavy, hard, strong and tough, and is much used for making handles of tools, carriage wheels and similar work requiring a very durable wood. It also makes a fine fuel. The nuts are mostly edible, and orchards are planted to certain species, especially the Pecan (*Carya pecan*).

It thrives best in rich, moist soil, although certain varieties do well under drier conditions. It is slow of growth, and difficult to transplant, and hence the seeds are often planted where the tree is desired. The various species can be grafted on each other readily, the Bitternut (*C. cordiformis*), forming an especially good stock. The tree is somewhat subject to attacks by certain insects and fungi.

CHINESE HICKORY STRIKINGLY SIMILAR

The Chinese Hickory (*C. cathayensis*, Fig. 15), recently discovered by Meyer, is a tree of 35 to 60 feet in height, and in every point has been proved to be a true hickory. It is found in Chekiang, and in the mountains around Changhua Hsien, about 70 miles west of Hangchou, growing at an elevation of about 400 feet above sea-level. The upper surface of the leaves has the soft greenish color typical of all the Hickories, while the under surface is rusty brown. Due to this peculiar coloration, a group presents a reddish-brown blotch of color in the midst of ordinary green vegetation, when the wind blows. The nuts are collected for sale, eaten as a sweetmeat, or made to yield fancy pastries. The wood is very tough and much used for tool handles. The inhabitants realize the value of the tree to them, and hence it is generally spared when firewood is being collected. In a few localities, the mountaineers have even made small plantations of this tree near their houses. It thrives best at the foot of mountains and in narrow moist valleys, where it grows in deep rich humus. It loves shelter, and when exposed to much wind is liable to become crippled; nor can it stand much frost.

Of these three American trees, the Liriodendron, the Sassafras, and the Carya, formerly supposed to be confined entirely to North America, each is now found to have a single species existing in China. Why this country, almost at the Antipodes, should be the locality where the only relatives of these trees are found outside of America is a question which is well worthy of consideration.

It has been decided by geologists that China and America were at one time united by land connection and that the present separation has not always existed. Hence, the trees just described probably grew continuously from China to the eastern United States, with but slight differences between different localities no greater than those now to be found between various parts of the United States.

When the land connection was severed, conditions were such that the trees became centered in the eastern part of this country and in localities of similar climatic conditions in China. The growth was now discontinuous, broken by the Pacific Ocean and the arid plains of the far west. Under such conditions, the Chinese and American species grew on and, although far apart and subject to different conditions, remained practically identical through hundreds of generations. In the two widely separated localities, due to their adaptability, these species were able to

survive, and present today one of the most striking examples of similarity in floras due to survival of related species after separation.

There appears to be not the slightest reason why such a tree as the Liriodendron should not be found in England or some European locality just as well as in China for when planted there it will grow and seed, and no explanation has yet been devised which points out any valid cause for its absence. It simply is not found there. But although its absence in Europe is not accounted for, its presence, together with the Hickory and Sassafras, in China forms a striking example of similarity in widely separated floras due to the survival, through adaptability, of three common species of American trees.

Lowered Birth Rate in Germany and Hungary

Although reliable statistics are now hard to secure, scattered but fairly representative reports indicate that the population of Germany is shrinking, more from a lowered birth rate than from actual casualties on the front, in spite of the efforts the German government is making to produce children for the fatherland

The statistics of the Mannheim Bureau giving birth and death rates before and after the outbreak of the war, as quoted in *Eugenical News*, March, 1918, are typical of the situation now existing. In 1914, the birth rate per thousand was 29.01, with a death rate of 13.13, leaving an excess of birth of 15.68 per thousand. In 1917, the birth rate has shrunk to 16.57, while the death rate, enlarged by war losses and abnormal conditions, has increased to 17.28, resulting in a deficiency of 0.71 per thousand in the birth rate. There is a great increase of deaths among persons over sixty years of age, due to the poor food and anxieties of war.

Hungary seems to be but little better off. The following statistics were read by the Karolyist deputy, Lodovico Hollo, to the Hungarian Chamber of Deputies, at the session of January 16, 1918.

"Births.—Before the war 765,000 children a year were born in Hungary. In the first year of the war, 1914, the number of births was reduced by 18,000; in 1915 only 481,000 children were born—that is, 284,000 less than in time of peace. In 1916 the number of births was 333,000—that is, a reduction of 432,000. In 1917 the births amounted to 328,000—that is, the reduction was 438,000. Therefore our losses (in Hungary alone) behind the front reach the number of 1,172,866 individuals.

"Deaths.—Whereas in time of peace infant mortality, for a period of seven years, was 34 per cent, in 1915, the proportion was increased to 48 per cent, and in 1916 to 50 per cent."

"These facts," said Hollo, "prove what sacrifices Hungary is making, to the prejudice of her own people, to continue the war."

Citrus Hybridization

In the spring of 1914 extensive hybridization of citrus fruits was begun at Riverside. Crosses have been made between varieties of orange, lemon, pomelo, and mandarin (tangerine), besides a few crosses of bergamot orange. These crosses are partly within the botanical species, for instance between Valencia orange and Mediterranean Sweet orange; many, however, are between different species, as between Dancy tangerine and Marsh pomelo.

BEE KEEPING MAY INCREASE THE COTTON CROP

Fertilization of the Cotton Flower Takes Place Soon after Sunrise— Twenty-Five to Fifty Pollen Grains Necessary for Each Flower —Shedding of Bolls Often Due to Imperfect Fertilization

ROWLAND M. MEADE, *Bard, Cal.*[1]

THE percentage of cotton flowers that develop into mature bolls is generally low. Even under the most favorable conditions many of the buds do not reach the blooming stage, and many flowers that open fail to set bolls.

A test of twelve Upland varieties made at Bard, Cal., in 1911, showed that during the first thirty days of flowering, 44 to 66% of the flower buds aborted before opening, and that 22 to 52% of the flowers that opened failed to develop into bolls. An examination of all the nodes on the fruiting branches at which it would have been possible for bolls to develop showed that at only 12 to 23% of these nodes were bolls produced.

In the same series of varieties at San Antonio, Tex., in 1912, 35 to 82% of the flowers that opened failed to mature bolls. The shedding at San Antonio was doubtless due largely to unfavorable climatic conditions, as drought, and, also, to the depredations of the boll weevil. The boll weevil, however, is not present at Bard, and as irrigation is practiced the lack of water could hardly be an important factor. Inadequate pollination was considered as a possible cause of the shedding, when the flowering stage had been reached.

The cotton flower is a large, cup-shaped blossom; it is borne in an upright position on the upper side of the fruiting branch. The structure and relation of floral parts are shown in Fig. 16. The pollen grains are very large and have moist spinose surfaces, so that they tend to cohere when freed from the anthers and are not carried about by the wind.

PERIOD OF FERTILIZATION SHORT

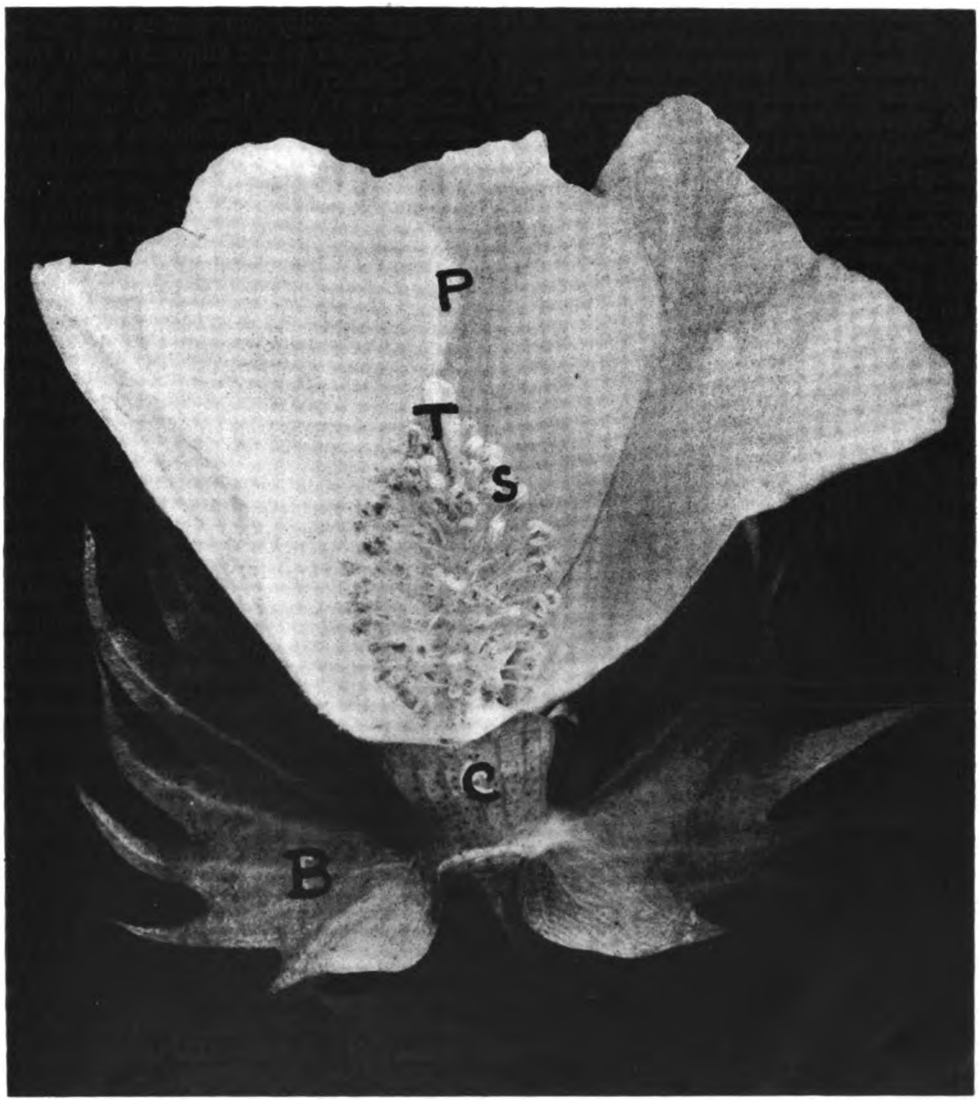
The period during which fertilization is possible lasts only a few hours. The flowers open soon after sunrise, commence to wither as the temperature rises in the middle of the day, and close in the evening, when the stigmas are dry. The second or third day after blooming the petals, stamens, and pistil separate from the rest of the flower and fall from the plant.

In some types the relative position of the stigmas and stamens is favorable, and in others unfavorable, for self-pollination. This doubtless partially accounts for the differences between varieties with respect to the percentage of flowers that develop into bolls.

LONG STAPLE COTTON OFTEN SELF-STERILE

Most of the flowers with long stigmas projecting above the stamens do not become completely self-fertilized, as the anthers and stigmas are too widely separated. The flowers of many of the long staple varieties are of this type, the stigmas often exceeding the anthers by 15 mm. (See Fig. 17.) The bolls resulting from such flowers have 23 to 50% of aborted seeds, and it seems not unreasonable to attribute this abortion in part to the lack of perfect pollination. Flowers with short stigmas imbedded among the upper stamens are readily

[1] This report was found among the papers of the late Rowland M. Meade in essentially the same form as presented.—J. H. Kempton.

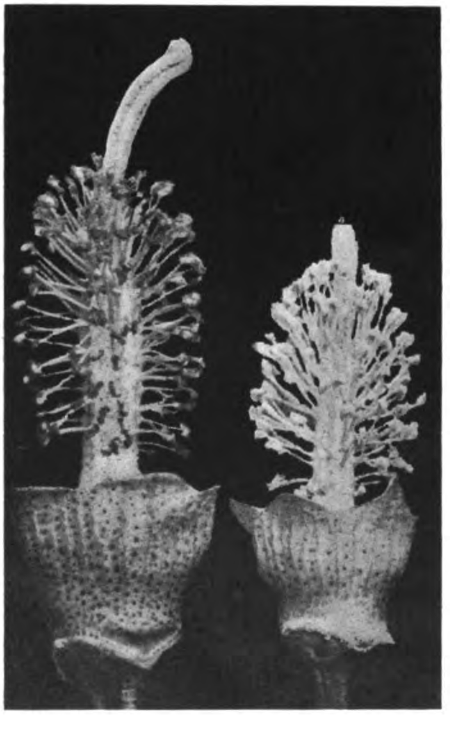


AN UPLAND COTTON FLOWER

A dissected flower enlarged two diameters to show construction. *B*, bracts; *C*, calyx; *S*, stamens; and *P*, petals. *T*, stigma protruding above the stamens. Insects can easily visit the stamens and collect pollen without ever touching the pistil which projects above the stamens. (Fig. 16.)

self-fertilized. Such an arrangement is shown in Fig. 17. Erect stamens, either long or short, are also favorable to self-fertilization, since they bring the anthers in close proximity to the pistils.

Cotton bolls have three to five locks or compartments, each containing six to eleven ovules, the number varying with the type of cotton. Few locks of long staple types contain more than nine seeds, while most of those of big-bolled, short, staple types have at least eight seeds, but mature bolls in which all of the seeds are fertile are rare. In the bolls of Upland varieties 10% to 25% of the ovules fail to develop into seeds. There is usually a slightly higher percentage of aborted seeds in the bolls of the long staple types.



COTTON FLOWER TYPES

Section of an Upland X Egyptian cotton flower on left, showing long exserted pistil. Flowers of this type are seldom completely self-fertilized. Section of a short stapled Upland cotton flower on right, with short pistil imbedded among the stamens. Flowers of this type are usually self-fertilized. Enlarged two diameters to show detail. (Fig. 17.)

LARGE AMOUNT OF POLLEN NEEDED

It was found by preliminary investigation that the bolls failed to set unless at least twenty-five grains of pollen were applied to the stigmas; even with this number only one or two seeds matured in each lock. As each lock contains from six to eleven ovules, it is necessary for at least twenty-five to fifty-five grains of pollen to reach the stigmas in order that all the ovules of a four or five-locked boll be fertilized.

An experiment was conducted at San Antonio, Tex., during 1913, to determine whether an increase in boll production might be expected as the result of complete pollination. Two varieties of cotton were chosen for this investigation—Durango, a long, staple type with stigmas exserted beyond the stamens, and Acala, a short, staple type with short stigmas embedded among the stamens. The separation of the anthers from the stigmas in the Durango flowers reduces the chance of self-fertilization, while the conditions found in Acala cotton favor self-fertilization. Two rows of each variety were planted for this experiment.

EXPERIMENT EXPLAINS DIFFERENCE

One of the rows of each variety was designated as *A* and the other as *B*. The flowers in the *A* rows were completely self-pollinated, anthers being removed by hand, and the pollen scattered over the pistil until the stigmas were well covered. The flowers in the *B* rows were allowed to become pollinated naturally.

A small string tag with the date of opening of the blossom was securely fastened about the branch at the base of the flower to mark the position of each flower that failed to develop into a boll. The hand pollination in the *A* rows produced the effect that might be expected from the work of bees or other pollinating insects operating in great numbers, except that the manipulation of the stigmas may have been slightly injurious. There were no indications of this, however, and, as far as possible, normal conditions were provided.

The experiment was carried on during the early part of the season, when conditions were favorable for growth, and were discontinued after July 10, because of extreme drought and the presence of boll weevils.

At the end of the season a complete record was taken of the matured bolls and of the vacant nodes bearing tags. It was thus possible, each day's record having been kept separately, to determine the percentage of flowers of each day that developed into mature fruit.

ARTIFICIAL POLLINATION BETTER

The results of the experiment are shown in Table I (see Appendix). As was anticipated, better results (an increase of nearly 11%) were obtained by artificial pollination in the Durango cotton than in the Acala variety, in which the increase was only about half as great. As before stated, the flowers of the former have exserted pistils, not adapted for perfect self-pollination, while those of the latter variety have short pistils.

The lowest percentages of bolls produced were found in the open pollinated rows of both varieties, while the highest percentages were found in the hand pollinated rows. In the open pollinated row of Durango, the lowest and highest percentages of bolls produced were 11 and 69.6, respectively; in the hand pollinated row, 32 and 81, respectively. In the open pollinated Acala row the lowest and highest percentages were 23 and 59, respectively; in the hand pollinated row, 34.8 and 65.5, respectively.

No effort was made to exclude insects, and the weather conditions during the course of the investigation were not unfavorable to their activities. It is evident from the increased yield of bolls secured in the long-pistiled Durango variety through artificial pollination that the presence of additional pollinating insects would aid in reducing the high percentage of shedding. The value of honey bees in this connection is recognized in some localities, and it would seem that growers of long-stapled varieties might find bee-keeping a distinct advantage to the cotton crop.

Counting the Feeble-minded in New York

After going over the ground carefully, the Committee on Mental Hygiene of the New York State Charities Aid Association submitted to the Hospital Development Commission an estimate of the number of feeble-minded in the State, and placed the number conservatively at 35,000. *The Eugenical News*, March, 1918, makes the just criticism that "counting" the feeble-minded is largely a subjective matter, and that many farmers would gladly pay $2.00 a day and board during harvest to a feeble-minded youth who would be unable to be self-supporting in New York City.

However, this estimate of the Mental Hygiene Committee, although doubtless far from being an actual count, should do much toward awakening public feeling to the necessity for adequate provision for the feeble-minded and feebly inhibited.

APPENDIX

The Cow in Calf Deserves More Honor

(*See article on page 250*)

TABULATION OF RECORDS OF 1,497 COWS ENTERED IN THE 1916 VOLUME OF THE REGISTER OF MERIT PUBLISHED BY THE AMERICAN JERSEY CATTLE CLUB.

Age of cow years	No. of cows studied	Milk yielded, pounds	Fat yielded, pounds	Require-ments, fat, lbs.	Require-ments are less than produc-tion	30% less than actual production lbs. fat	22% less than actual production lbs. fat	Standard-ized to 25% less than production lbs. fat
					A	B	C	D
1 yr. A	86	6267.3	337.7	250.5	26%	236	....	253
AA	67	6226.5	335.9					
2 yr. A	278	6707.3	359.2	250.5	30%	250	280	269
AA	224	6712.6	362.4					
3 yr. A	126	7495.9	399.1	287	28%	279	....	299
AA	96	7082.5	383.6					
4 yr. A	112	8230.8	449.4	323.5	28%	314	....	337
AA	73	7747.8	417.5					
5 yr. A	91	8221.9	441.5	360	19%	309	344	331
AA	57	8307.8	430.6					
6 yr. A	60	8489.9	460.1	360	22%	322	....	345
AA	52	8167.5	429.6					
7 yr. A	47	9029.5	477.1	360	25%	334	....	358
AA	29	8171.7	439.4					
8 yr. A	29	8754.8	461.8	360	22%	323	....	346
AA	16	8507.6	464.7					
9 yr. A	25	8718.2	476.6	360	25%	333	....	357
AA	10	8456.2	442.6					
10 yr. A	11	8887.6	463.8	360	22%	323	360	348
AA	8	8916.0	460.1					
Average	....	....	....	....	25%			

Bee Keeping May Increase the Cotton Crop

(*See article on page 282*)

TABLE I.—*Comparison of percentages of bolls developing from open pollinated and hand pollinated flowers in Acala and Durango cotton, San Antonio, Tex., 1913*

Durango cotton

Date of flowering	Hand pollinated row: No. of flowers	Hand pollinated row: No. of bolls setting	Hand pollinated row: Percentage of bolls produced	Open pollinated row: No. of flowers	Open pollinated row: No. of bolls setting	Open pollinated row: Percentage of bolts produced	Difference in favor of hand pollinated row	Average difference in favor of hand pollinated row
June 27	25	8	32.0	27	3	11.0	+ 21.0	
28	17	7	41.2	26	10	38.4	+ 2.8	
30	29	19	65.5	22	8	36.3	+ 29.2	
July 1	44	26	59.1	36	25	69.5	− 10.4	
2	66	43	65.2	64	36	56.3	+ 8.9	
3	59	44	74.6	60	41	68.3	+ 6.3	
5	73	48	65.8	52	32	61.5	+ 4.3	10.96 ± 2.2
7	75	61	81.2	79	55	69.6	+ 11.6	
8	84	64	76.2	62	58	61.3	+ 14.9	
9	94	70	74.5	86	57	66.2	+ 8.3	
10	69	56	81.2	66	38	57.5	+ 23.7	

Acala cotton

Date of flowering	Hand pollinated row: No. of flowers	Hand pollinated row: No. of bolls setting	Hand pollinated row: Percentage of bolls produced	Open pollinated row: No. of flowers	Open pollinated row: No. of bolls setting	Open pollinated row: Percentage of bolts produced	Difference in favor of hand pollinated row	Average difference in favor of hand pollinated row
June 27	8	4	50.0	9	4	44.5	+ 5.5	
28	16	8	50.0	13	3	23.0	+ 27.0	
July 1	29	19	65.5	37	22	59.4	+ 6.1	
2	54	25	46.2	62	35	56.5	− 10.3	
3	66	28	42.5	76	39	51.3	− 8.8	
5	62	26	41.9	70	22	31.4	+ 10.5	5.31 ± 2.45
7	89	31	34.8	109	45	41.4	− 6.6	
8	118	39	38.0	110	23	21.0	+ 17.0	
9	145	61	42.0	163	63	38.6	+ 3.4	
10	122	57	46.8	152	57	37.5	+ 9.3	

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"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

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The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. IX, No. 7 November, 1918

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NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX will contain only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

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Date of issue of this number, December 12, 1918.

PETSAI AND LETTUCE COMPARED

In the upper plate is shown a head of lettuce at the left and a head of petsai at the right. In the lower plates are lettuce salad at the left, petsai salad at the right. (Frontispiece.)

THE CHINESE PETSAI AS A SALAD VEGETABLE

David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, Washington, D. C.

IN THE most remarkable book which has been written on the agriculture of the Chinese ("Farmers of Forty Centuries"), Dr. King points out that the farmers of China, through a wide use of immature forms of vegetation as food, are able to produce an immense amount of food that would otherwise be impossible. These quick-growing leafy vegetables produce a crop of green leaves in a much shorter time than the plants whose seeds are eaten require to ripen a seed crop. This fact allows of the production of more crops and a larger amount of food, per year. Leafy vegetables are furthermore, sown and matured in the early spring and the late fall when the hours of sunshine are too few each day to permit of the ripening of grain seed crops, that require a long period for development.

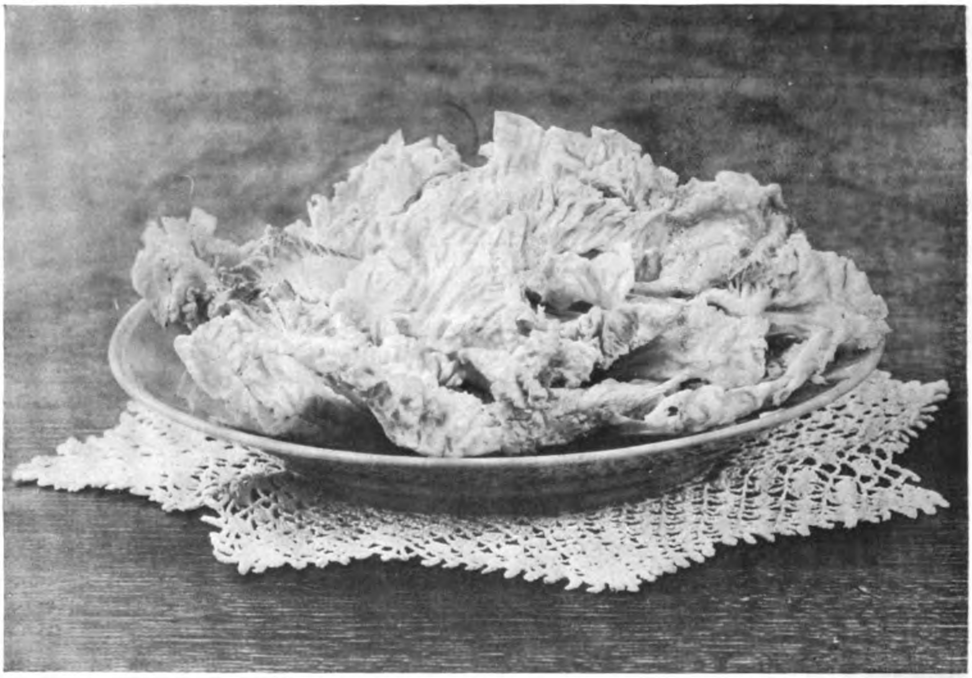
The recent discoveries of Dr. McCollum, of the Rockefeller Foundation, show that there is in the green leaves of plants the same substance which is found in butter and which he has designated "fat soluble A." This is one of the so-called vitamines and is as essential to the growth of the animal body as the carbohydrates, fats or proteins of meats, cereals, eggs, and vegetables. That animals cannot live and grow without this substance has given a new importance to the leaf vegetables in our dietary.

To Americans, lettuce has become the great salad vegetable, and throughout the year it is grown in some part or other of the country, and in the winter either shipped thousands of miles to our tables or grown under glass near our great cities at a considerable expense of coal; over 40,000 tons are so grown.

In the Chinese Petsai we have a rival of the lettuce in so far as any vegetable can rival another. It deserves at least to be given the serious consideration of Americans as a supplement of lettuce. It can be produced for about half the money. It can be grown everywhere throughout the country. It is a better keeper than lettuce and, pound for pound, it probably contains as much of the valuable substance for which we eat lettuce—the "fat soluble A." Furthermore, in appearance it is more attractive.

The question of a new vegetable is so tied up with our taste, and our taste is so dependent on the name, that the term "Chinese cabbage" should never have been given to this representative of the mustard family. Technically, it is not a cabbage, and why prejudice people against it who do not care for cabbage. It is hard for the average mind to believe that anything which has the name of cabbage attached to it could by any means possible be made into a rival of the delicate lettuce when dressed with a French salad dressing and eaten in the same way.

That petsai is a rival and that we should take it into our menu and make a place for it, there is no longer any doubt in my mind. The testimony of unprejudiced people who have tried it, and the fact that there are areas of the country where the same amount of this rival can be produced easier and more cheaply than can lettuce, are facts



A SALAD OF CHINESE PETSAI

In brilliancy and crispness and in keeping qualities the petsai is undoubtedly superior to the lettuce and it rivals lettuce in palatability. Furthermore, a seed crop requires several months of really warm weather to mature in, whereas a leafy vegetable can produce a crop of leaves in a few weeks of early spring and in the cool days of late fall. This economy is understood by the Chinese. (Fig. 1.)

which during these times ought to appeal to every patriotic citizen.

To insist that we shall be fed on the more expensive of the foods and to refuse to eat the easier produced ones is an attitude of mind at variance with the spirit of the day.

Where can we get the most food for the money and the best of its kind and of the kinds which will keep employed every acre of land and every unemployed farmer and his equipment, are questions which the consumer should ask himself.

Of course there is no question but that this country could, in the course of years, shift its agriculture to such a degree that it would be living and working on a small fraction of the cost which it now requires to feed it. Imagine the saving which a return to a millet diet, such as is still in use by the Chinese in Manchuria, would bring about. How long it would take to adapt our digestive tracts to such a diet it is hard to say, but no doubt it could be done.

There are certain kinds of economies which Americans in their handling of the food question can bring about, but there are others in which it is hard to imagine any great and immediate changes. In the growing of vegetables and the getting them into the hands of the consumers a degree of hand labor is absolutely necessary. If labor remains at $3 a day this item in the cost of production will not be decreased, and it is hard to see how the cost of lettuce to the consumer can be brought down so long as these prices for hand labor continue.

If, for the same amount of hand labor, double the amount of just as good a vegetable as lettuce can be produced, there is a direct saving which deserves to be seriously considered. The only thing which stands in the way is the fashion for lettuce—the fact that every-

body likes lettuce and few know petsai. The Germans brought themselves to eat over five hundred substitutes for the things which they were fond of before the war, and Americans must learn that they cannot continue to do their utmost to help the Allies and eat just the same things which they ate before. Now is the time to take stock of the cost of production and see whether there are not cheaper things to grow than some which our fondness for certain flavors has induced the farmer to produce.

The production of roast pig has already been brought under a scrutiny, and the cost of that roast pig is now well understood. The comparative costs of producing roast beef and mutton are facts of which the public is getting every day a clearer appreciation. But the cost of fruits and vegetables and their comparative food value is one which as yet has scarcely touched our consciences.

The largest truck grower in New Jersey and one of the most successful in America has grown the petsai for several years and declares that the cost of growing and marketing it is about half the cost of growing and marketing lettuce, but more than the cost of producing field cabbage. If he could get for petsai anything approaching what he can for the lettuce he would put in a large area of it next year and make a lot of money. What he would do the other truck growers would be willing to do, and there would need be no dearth of this delicious vegetable.

If he could get for it even considerably less than the prevailing price for lettuce he would make money and the consumer would save money by eating a salad which is, after all, quite as delicious as lettuce and just as nutritious. What stands in the way of this saving? The taste for lettuce, nothing more.

In China, where a few years ago a farm laborer received an equivalent of only $21 a year, the equivalent at that time of about two weeks' work of our farm labor, this particular vegetable is grown everywhere, and it can hardly be doubted that it is grown as much as a matter of economy as for any other reason. If the Chinese feel they must grow this cheaply produced vegetable to save labor that costs only $21 a year, how can we refuse to grow it for the same reasons under the stress of the war's demands—just because we are unaccustomed to it and do not think it will taste as good as the lettuce with which we are familiar.

It might be claimed that we could make a salad out of the ordinary cabbage, which would be good enough, and that since this is still easier grown than the Chinese cabbage we would be saving still more by the economy.. I doubt if this is practicable at the present time, for there are so many people who do not like cabbage—cannot eat it, in fact, without discomfort—that the number of people who would give up lettuce and eat cabbage would be nothing like half the number who would take up this new salad which has no cabbage flavor when properly prepared. The saving therefore would be greater in the substitution of this Chinese petsai than it would be in any attempt to substitute ordinary cabbage for lettuce.

How can this introduction be brought about? By starting a craze for the Chinese petsai. If the demand is created the growers will produce the vegetable. What they are afraid of is its overproduction and what the Government can do is to stimulate the consumption. If the latter is stimulated the production will take care of itself. This stimulation of consumption will benefit those who grow the petsai, it is true, but as anyone can grow it, there will be no unjust discrimination.

There is this further advantage in the introduction of a new vegetable as opposed to the substitution of an old one. Every vegetable has its optimum climatic and soil conditions; these are not likely to be the same for the Chinese petsai as they are for the other vegetables, and in the course of time we will find there are certain areas which because of their peculiar fitness to grow the petsai have become famous for the excellence of the heads produced. This is the case in China where for forty

centuries this vegetable has been grown, and there is no reason why it should not be the case in this country. It is only by the shifting of crops and the addition of new ones to our list that this country is to be completely farmed to that degree of perfection which will be necessary if we are ever to support the vast population which we expect to support.

Is the Chinese petsai worthy of this effort to establish it in our horticulture? Many testimonials of people who have eaten it and who are unprejudiced can be adduced to show that it is.

TESTIMONIALS

While it is undoubtedly true that it requires years to test a new vegetable and be sure that it will stand the test of continuous use, there are certain facts which make it seem probable that the introduction of the petsai can be accomplished in a reasonable length of time in this country.

The American is learning to eat many new things He is in this respect in a stage advanced over that of the modern European. His menu is a hodgepodge already of the menus of Italy, France and England, with those of Russia, Greece, and Hungary thrown in. Ours is the melting pot of menus, so to speak, and into it have come in the last twenty years the grapefruit, the avocado, the ripe olive, the casaba melon, the honey-dew melon, the wild rice, the dasheen, the sand dab, the tile fish, the green asparagus, the endive or whitlof, the globe artichoke, the soy bean, the Japanese persimmon, the mango, and others.

The Chinese restaurant has become a factor in our cities and thousands of Americans have come to appreciate the new flavors and textures of foods which are served there. This petsai is one of the staple vegetables of the chop suey, and without knowing it many thousands of Americans have tasted and liked it and will continue to do so in increasing numbers as the years pass.

A vegetable which comes to us while we are in this formative state of mind regarding foods is not likely to be thrown out again if, like petsai, it has the great advantage of cheapness and has stood the test of centuries on the other side of the Pacific. We must not forget that nearly all of our plant foods have come to us one by one from foreign peoples and generally represent the discoveries of primitive peoples somewhere in the world. There seems to be a biological drift toward the enlargement of the menu of civilized man, and this drift is taken advantage of by the manufacturers of new foods who control their production.

Why should it be considered the wisest thing for the people in these matters of foods to be left to the influences of private salesmanship? Our food chemists know the approximate food value of most of the foods sold on our markets, but the people do not. And because they are ignorant the manufacturers of foods spend millions to teach them the value of their particular product. They make house to house visits by the thousand to demonstrate the use of some special food for which they charge often more than it is actually worth. The people have no way of finding out what it is really worth and they learn to like it and find it hard to do without. This habit, fixed by the skillful salesman, becomes the source of revenue to the manufacturer, regardless of whether a thousand calories of it cost the consumer three cents or ten cents.

On the other hand we have here in the Chinese petsai a product which is actually cheaper to produce, has presumably the same food value as lettuce, and because no food manufacturer can control its production with some trademark or patent, and because there is no advertising agency which can take it up and make a house to house canvass and teach people to eat it, years or even decades pass before, through the slow and tedious process of gradual popularization, it finally comes into our menu and stays there.

Supposing we take a conscious direc-

tion of these food habits into our hands, and, on the ground of chemical analyses and dietetic experiments carried out on rats and guinea-pigs and "poison squads" of men and women, determine the real value of these new foods; then by experiments on the farms find out the relative cost of growing them, the best places to grow them and the extension of territory which will result by their cultivation; then on the basic groundwork of sound knowledge conduct a campaign of publicity such as no food manufacturer even dares to conduct and plant the new food product in the minds of the people where it will remain until something better is discovered.

Heredity of Stature in Man

Dr. C. B. Davenport, Director of the Department of Experimental Evolution of the Carnegie Institution of Washington, in coöperation with the Eugenics Record Office, has completed a study of inheritance of human stature, which has been published in *Genetics*. "Stature has long been a classical object of investigation, largely because it is so readily measured. Thus, in 1889, Galton published his studies on stature in parents and children and their interrelation. This led to Professor Karl Pearson's remarkable series of investigations, 'Mathematical Contributions to the Theory of Evolution,' that founded the biometric school, which has left its imprint on biology, though it has proved disappointing in its assistance to the study of heredity. Though stature is the end-result of a number of independently varying elements, still, because of facts that determine growth as a whole, and because the length of the separate segments of stature are separately inheritable, it is possible to find some law of inheritance of the trait.

The present study was made on data derived from 3,298 children, their 1,738 parents, and a number of grandparents, uncles, and aunts. A large proportion of these were especially measured at their homes in various parts of the country. The hypothesis is supported that while short parents tend, on the average, to have short children, they may, and frequently do, carry germ-cells which lack the shortening factors; on the other hand, all of the children of tall parents are tall. Consequently the offspring of two very short or short parents are more variable in stature than the offspring of two very tall or tall parents as 2.4 is to 2.2. Also, whereas the offspring of two very short or short parents tend, on the average, to be less extreme than the parents, this is not true of the offspring of two very tall or tall parents.

Not only is stature as a whole inherited, but also, and even more clearly, each segment of stature, such as neck, length of torso, thigh, and foreleg; and the inheritance of the length of these segments follows the same law as does stature as a whole. An interesting by-product of this study is that persons of similar stature tend to marry each other, and the more extreme their stature the more particular are persons in this respect. Among 869 matings that of a very short man to a very tall woman occurred only once, or one-tenth the expected number of times, while the marriage of a very tall man to a very short woman did not occur at all."—*From the Annual Report of the Director,* 1917, pp. 128-129.

THE APPROACHING EXTINCTION OF THE MAYFLOWER DESCENDANTS

We Are Soon to Celebrate the 300th Anniversary of the Landing of the Pilgrims. If Their Present Birth Rate Continues for Another 300 Years, It Will Be Possible to Put All the Surviving Descendants Back Again Into the Mayflower, and No Overcrowding

S. J. Holmes and C. M. Doud
University of California, Berkeley, Cal.

THE data upon which this paper is based were obtained partly from a biographical study of Mayflower families, and partly from the results of a questionnaire sent to the members of the California branch of the Society of Mayflower Descendants. We are indebted to Mr. Herbert Folger, the historian of the California branch of this society, for a list of the names and addresses of members and for his kindly interest in our work. We wish also to thank the numerous Mayflower descendants who have taken the trouble to answer the questionnaire sent to them.

The questionnaires were furnished with spaces for filling in the desired data, which included the ages of husband and wife, date of marriage, number of children, including those stillborn, the number of children in the family of the father and mother of the Mayflower descendants, and a query concerning what may have seemed to many a mere matter of idle curiosity—the religion of both husband and wife. Data were also requested concerning the dates of marriage and number of children of any descendants of the present members.

The statement of religious affiliation was requested with a view of ascertaining what correlation might exist between the religious belief of parents and the size of their family. Families are unusually large in certain sects, such as Catholics and Jews, but our data were not sufficient to enable us to draw any conclusion as to the correlation between religion and fecundity in the group of people investigated.

Of the 241 questionnaires sent out. 116 were returned, but 10 of these were imperfectly filled out, so that they could not be used. Records were obtained sufficiently complete for our purpose from 106 families. It is hardly probable that incompleteness of returns would introduce any qualitative differences of importance in the data. Those having no children might be somewhat less apt to fill out and return the blanks; if so, the reduction in the size of the family would be somewhat greater than our records indicate.

We have grouped families according to the date of the birth of the parents. Most of our data concerns individuals born in the two 20-year intervals, 1840-1860 and 1860-1880. There are fewer records of the families of individuals born between 1820 and 1840, but these show a considerably higher birth rate than the families belonging to subsequent decades. The families of individuals born after 1880 cannot be considered complete, since more children may be born in them. Parents, both of whom were born between 1860 and 1880, may, in rare cases, produce more children.

but not enough to sensibly influence results. The youngest woman in this age group would be 38 years of age. There are, as a matter of fact, only eight women in this group under 45 years of age, and judging from the children born between the ages of 38 and 45 in our group, the additions to the race from this source will doubtless be very few. We have made separate tabulations of the number of children of parents, both of whom were born in the second half of this interval, i. e., 1870 to 1880, and it shows the startlingly low record of only 1 5/10 children per family.

DECLINE IS STEADY

The general decline in the size of the families of the Mayflower descendants is clearly indicated by the table (see appendix). The first horizontal column includes the number of children in the families of the Mayflower descendants to whom questionnaires were addressed. It shows that the decrease in the size of the family has gone on steadily with the decreasing age of the married couples down to the year 1880. The families of Mayflower descendants born after this date naturally show a further decrease, but as these families may not in all cases be completed, there is no means of knowing how much of this decrease may be due to a further decline of the birth rate.

In the second horizontal column is listed the number of children in the families of the mothers of the persons addressed, and in the third is a list of the number of children in the father's family. The numbers in both of these columns also show a declining birth rate. In general there are fewer children in the family of the mother than in that of the father. This is doubtless to be attributed to the fact that since mothers are, as the returns show in nearly every case, younger than the fathers, and often several years younger, they belong to rather more recent families than those of their husbands, and, therefore, to families in which the birth rate is more reduced.

It is well known that up to about a half century ago the Mayflower descendants were noteworthy on account of their high fertility, as is indicated by their very rapid increase in a few generations to many times their original number. An examination of the published genealogies of several of the Mayflower families shows the frequent occurrence of 8 to 10 children per family; and even larger families were by no means rare. In order to secure data on the fertility of this stock, before the period covered by our questionnaire, we have tabulated the average number of the children in the genealogy of the Brewster family, which has been compiled by Emma C. Brewster Jones. In this extensive work the data on the various families are grouped under the successive generations which have appeared since the landing of the Pilgrims. It was, therefore, a small task to compute the average size of the families in successive generations. As only those families are listed in which at least one child was born, the data is not strictly comparable to ours, which include sterile unions. Were the latter included, the average size of the families of the Brewster descendants would be somewhat reduced, although childless marriages were formerly less common in this stock than among present-day Mayflower descendants. The data, which were based on the comparison of several hundred families, show clearly the decline of the birth rate during the last three generations.

In our estimate of the average number of children per family, we have included all the families in the Brewster genealogy up to the eighth generation. For the two subsequent generations, on account of the large number of individuals recorded, we have based our estimate on the first two hundred families of the eighth generation, and the first three hundred of the ninth generation, and we have considered only those cases in which the ages of the parents insure that the family is a completed one.

The size of the families of the first three generations is obviously of little significance on account of the small number of individuals included. The numbers in the following generation rapidly increased. The fourth generation contains 23 families; the fifth, 52; the sixth, 121; the seventh, 275, showing that the number of fertile unions more than doubled in each generation. About the same rate of increase is shown by counting the total number of children of these families, which are as follows: Thirty in the third, 155 in the fourth, 359 in the fifth, 864 in the sixth, and 1,760 in the seventh generation. The average number of children per family in successive generations is shown in the table (see appendix).

The ninth generation comprises people whose parents lived for the most part in the first half of the nineteenth century. Their birth rate corresponds roughly to that of the parents of existing Mayflower descendants from whom we have received returns from our questionnaires.

DECLINE IS RECENT

The evidence from the two sources we have considered indicates that the birth rate has been falling more or less for the last 100 years, but the rate of fall has been more rapid in the latter half of this period. This is what one would expect in the light of the general decline of the birth rate, especially among people of fairly high social status.

It must be admitted that the members of the Society of Mayflower Descendants represent a more or less selected body of individuals, and that if all the descendants of the original band of Pilgrims were investigated, the average birth rate would be found to be somewhat higher. It is also possible that the birth rate among members of the California branch may be somewhat lower than it is among those residing in other states, but, however this may be, there is little likelihood that the birth rate of the entire group would come near being sufficient to insure the propagation of the stock without loss.

The results we have obtained are quite comparable to those of several other studies on the decline of the birth rate among people of American birth. The average family of the present Mayflower descendant is comparable in size to the families of the graduates of Harvard, Yale, and other universities and colleges, and to the families of American men of science studied by Cattell. These families average somewhere between 2 and 2 5/10 children per married couple, which is a somewhat better showing than is made by the modern descendants of the Pilgrim Fathers. In fact, the average family of American-born parents, judging from all the data that have been collected on the subject, contains somewhat less than three children. With our present birth rate and marriage rate, nearly four children per married couple are required to perpetuate the stock without loss. It is evident that the people who are of American lineage for more than two generations are not reproducing with sufficient rapidity to rescue their stock from ultimate extinction.

MAYFLOWER'S CAPACITY

The data we have collected on the birth rate of the Mayflower descendants point to but one conclusion. With the present rate of reproduction there must be going on a rapid diminution in the number of this once rapidly multiplying band. To judge from the evidence in our possession, their rate of multiplication is scarcely one-half what it should be to keep the stock even stationary. This means that four generations would affect a reduction to 1/16 of its present numbers, and that in four more generations there would be only one representative to every 256 at the present time. We shall soon celebrate the 300th anniversary of the landing of the Pilgrims, but if their present birth rate continues for another 300 years, it would probably be possible to put all the surviving descendants back again into the Mayflower without overcrowd-

ing the limited capacity of that celebrated vessel.

Considering the rôle which the Mayflower descendants have played in the history of our nation, this result is certainly one to be greatly deplored. If there is a remedy for this evil it can only become effective, I believe, if the evil is clearly recognized. The consensus of opinion among most of those who have studied the fall of the birth rate is that the chief factor involved is the voluntary restriction of the size of the family. In these days the obligation of obeying the primal behest to be fruitful and multiply, rests very lightly upon most people. I seriously doubt if the majority even of educated poeple have ever thought of how many children per married couple are required to perpetuate the race. How often one may hear it said glibly that one or two children per family is quite enough! Without discussing the probable reasons for this almost incredible ignorance and indifference concerning one of the most important and elementary matters of moral obligation, it is evident that we need a more widespread appreciation of the dangers of race suicide and a change of attitude in regard to this among people who are the bearers of good inheritance. Since human beings have come to regulate the matter of their own perpetuation, it is essential that they act with an intelligent appreciation of the racial consequences of their conduct, and not merely from the standpoint of their personal comfort and convenience. The consequence of the reduction in the fecundity of those classes who are successful in reaching a fair educational standard and in attaining a modest degree of financial competence is to recruit the race mainly from ranks below mediocrity. The racial deterioration which would thus be entailed cannot be checked by limiting the propagation of mental defectives. A society in which those with superior inheritance do not perpetuate their stock will eventually suffer racial decay. Anyone who studies the present condition of the differential birth rate cannot escape the conclusion that this is precisely the condition in which our present generation in America finds itself, and there is no remedy for this situation that does not involve the increase of the birth rate among those of good inheritance, at least to the point necessary to perpetuate their stock.

It would be a task eminently appropriate for the Society of Mayflower Descendants to consider the problem of the ways and means by which it may rescue itself from extinction. Here is a field for really worthy endeavor, infinitely more valuable than tracing family histories or celebrating the achievements of one's ancestors. It is time now to look to the future rather than to the past. Should the Mayflower descendants succeed, in any degree, towards solving the problem of avoiding extinction, it will not only be a direct service to the country, but one of possibly much greater value through the influence of its example. The problem facing the Mayflower descendants is, of course, the same that, in our modern world, faces people who have risen to a higher social status. It can be solved, I believe, only by the effective dissemination of a sense of racial obligation. What keeps the population of civilized countries on the increase is a combination of various forces: ignorance, lack of prudence, religion, love of children, the economic value of children, and a sense of racial duty, etc. A stock tends to rise or fall, according to which of these forces predominate. Where ignorance and lack of restraint are the principal causes of differential fecundity, a people tends to be recruited mainly from its inferior strains. Where the higher incentives to fecundity prevail, the race tends to be replenished more from those capable of responding to such motives. The economic value of the child no longer affords a stimulus to family increase, and religion, while still influential in some sects, has largely ceased to make itself effective among Protes-

tants[1] and free thinkers. The mass of cultivated people at present persuade themselves that family limitation is a justifiable procedure, especially in a well populated country, but while they may be right in avoiding the burden of the large families of ten or twelve, which were not infrequently found among our Puritan ancestors, they are certainly not justified in carrying the restriction to the present extreme, which, if continued, would effectively dispose of their stock in a few generations. When they thoroughly appreciate this fact, as they do not at the present time, will they respond to the call?

Rehabilitation of Our Wounded

The United States Government is resolved to do its best to restore every wounded American soldier and sailor to health, strength, and self-supporting activity.

Until his discharge from the hospital all the medical and surgical treatment necessary to restore him to health is under the jurisdiction of the military or naval authorities, according to the branch of the service he is in. The vocational training, the reëducation and rehabilitation necessary to restore him to self-supporting activity, is under the jurisdiction of the Federal Board for Vocational Education.

If he needs an artificial limb or mechanical appliance, the Government will supply it free, will keep it in repair, and renew it when necessary. If, after his discharge, he again needs medical treatment on account of his disability, the Government will supply it free. While he is in the hospital and while in training afterwards the soldier or sailor will receive compensation as if in service and his family or dependents will receive their allotment.

A wounded soldier or sailor, although his disability does not prevent him from returning to employment without training, can take a course of vocational training free of cost, and the compensation provided by the War Risk Insurance Act will be paid to him and the training will be free, but no allotment will be paid to his family.

Every Liberty Bond holder who holds his bond is keeping up a part of this great work of restoring to health, strength, and usefulness the men who have suffered for their country.—*Treasury Department, Bureau of Publicity.*

Utah Experiment Station Aids Farmers in War Against Ground Squirrels

That war is declared against ground squirrels and other rodent pests in Utah is evidenced by the recent appearance of Utah Experiment Station Circular No. 29, "The Control of Rodent Pests," which is being rapidly distributed throughout the State.

The circular was prepared by Mr. Charles J. Sorenson, Instructor in Zoology at the Utah Agricultural College. The publication contains the latest and best methods for killing ground squirrels, pocket gophers, jack rabbits, and field mice, four groups of rodent pests which it is estimated cause an annual loss of not less than $2,000,000 to the farm crops of Utah.

Early spring is the best time of all the year in which to wage war against ground squirrels. It is then that the animals emerge from their winter's hibernation, lean and hungry. Their natural food is scarce, and as a consequence the animals will eat poisoned baits more readily than at other times when green food is abundant.

[1] See an interesting article by M. Booth on Religious Belief as Affecting the Growth of Population, in the *Hibbert Journal*, 13, pp. 138-154, 1914.

AN INTERESTING BUD-SPORT IN THE WASHINGTON NAVEL ORANGE

Of Our Commercial Varieties of Oranges, None Is More Erratic and Prone to the Production of Sports than the Washington Navel

ROBERT W. HODGSON, *University of California*

THE work of Mr. A. D. Shamel and others has called attention to the frequency with which bud-sports are found in Citrus and has indicated the importance of bud selection in the maintenance of our standard varieties. There is little doubt but that the genus Citrus represents one of our most unstable classes of commercial fruits, and this tendency to the production of bud-sports or mutations is apparently heightened by environmental conditions in California. Of our commercial varieties of oranges, none is more erratic and prone to the production of sports than the Washington Navel. Thus in the fifty years we have known this variety, there have appeared no less than six additional well defined strains of more or less commercial importance, namely, the Australian or Florida navel, the Navelencia, Golden Buckeye, Golden Nuggett, Thomson's Improved and Smith's Willow Leaf. Many others have doubtless occurred, but being decidedly inferior to the original strain, have not been propagated and still others exist in individual trees, but have not been recognized by growers.

The characters involved in the mutations are not always of a visible nature, but may be qualities such as "yield," or time of maturity, or acid-sugar ratio, and it is, of course, characters such as these that are of the greatest importance from the commercial standpoint. Mr. Shamel has devised what he calls the performance record to indicate trees possessing the quality of high yield, and the best of such trees are selected as "mother" trees from which buds are cut for propagation purposes. The principal objection to the performance record is that it fails to indicate mutating trees. Thus a tree may have several sport limbs and be decidedly unsatisfactory for the selection of bud wood and still yield relatively high, which condition is in no way indicated from the performance record sheet.

The writer recently ran across such a tree, in an orchard near Riverside, possessing a single limb quite unlike the remainder of the tree. The vigor and habit of growth of this branch, the leaf shape and color, and the quality and form of the fruit are very different from the rest of the tree. The sport limb occurs rather high up in the tree and toward the end of what was apparently a typical fruiting branch. At the point where the mutation took place the branch increases in diameter. The mutant limb has a greatly increased vigor of growth over the parent strain, as indicated by the increase in size of the stem as well as by the large, vigorous leaves, and an abnormal amount of fine twiggy growth. This vigor is also evidenced by the fact that the sport branch has acted as a sucker and has succeeded in starving the growth on the parent limb behind the point where the mutation occurred. All of this growth has died back, apparently from lack of nourishment. Indeed, the general effect of the limb on the tree has been of such a nature that the owner thought it was a mistletoe. (Fig. 2.)

The habit of growth is markedly weeping, the limb drooping until it touches the ground, although it originates at a height of seven feet or more. The branches are long and slender and

MUTATION IN THE WASHINGTON NAVEL ORANGE

Showing marked weeping habit of bud-sport. The owner thought this limb was a species of mistletoe. At the point where the mutation took place the branch increased in diameter. The mutant limb has greatly increased vigor of growth over the parent strain, as indicated by the increase in size of the stem, as well as by the large vigorous leaves. (Fig. 2.)

willowy in nature. (See Fig. 2.) The leaves are somewhat larger and decidedly longer than typical Washington Navel leaves and are a lighter green in color. The fruit is very coarse and irregular, with a tendency toward obtuse-pyriform shape, and pale yellow in color, in marked contrast to the rich orange of the navel. The quality is very inferior.

The striking appearance of this limb would no doubt deter a budder from cutting bud-wood from it, but as mentioned above, not all bud-sports are as visible as this. This fact emphasizes the desirability of a grower going over his trees very carefully when they are in fruit, for several seasons, before selecting "mother trees" from which to take bud-wood. It is not enough that the tree bear large crops, but every limb must be of the same strain and yield heavily, uniformly with fruit of good quality. Even the bud-wood should be selected only from limbs which are actually carrying fruit.

Fighting Instinct is Not the Warring Instinct

Mr. Paul Popenoe's interesting article in the October number of the JOURNAL OF HEREDITY, entitled "Is War Necessary?" suggests two points in regard to which the biology of the question appears to call for some further discussion.

1. Is not the fighting instinct something very different from the warring instinct?

The fighting instinct, that is to say, the instinct for personal combat, is an individual trait, finding an individual expression, as, for instance, in the "bad" man of the early mining camps. This instinct, having a very low survival value in a modern civilized environment, is probably disappearing under the pressure of a gradual elimination of the males in which it is strongly developed.

The warring instinct, on the other hand, is a group phenomenon, and is simply one phase of the instinct of gregariousness. As such it has a high survival value in the conflict between human groups; and it is not subject to an eliminating pressure. It is a mistake to suppose that the warring instinct is weakened by long periods of peace. In order that this effect should appear, we should have to accept the inheritance of traits acquired from the environment, a theory to which the opinion of biologists is almost universally opposed.

2. Is it a fact that "The argument that war is beneficial because it allows the fittest to survive . . . is now almost universally known to be fallacious?"

These questions are discussed at some length in the Introduction to Dr. Frederick Adams Woods' stimulating and suggestive volume entitled "Is War Diminishing?"

After pointing out that in actual warfare those who survive hardship and disease must be stronger than those who succumb, and that superior cunning and resourcefulness must also have a survival value, Dr. Woods says:

"If it be admitted that intelligence is a factor at all, then the more intelligent must themselves tend to escape, from the mere fact that they tend to do more of the killing. If strength and intelligence are of any value in a bayonet charge, then just so far as they tend to the killing of opponents so they must tend to the survival of their possessors. With artillery, indirect fire, telephones, wireless, and modern machine guns, intelligence must count for a good deal in the successful destruction of the enemy. Then it counts that much toward the survival of those who do the destroying."

It would appear to be a matter of importance that the points here raised should receive a full scientific discussion at this time. A symposium on the subject conducted by the JOURNAL OF HEREDITY would be of the utmost value.

ALLEYNE IRELAND,
St. Botolph Club, Boston, Mass.

FRUITING OF APPLE TREES EVERY OTHER YEAR

Reasons Why Apple Trees Bear Heavy Crops Every Other Year—Illustration of a Gravenstein Graft Alternating with the Original Tree

B. S. BROWN

Head of the Horticultural Department, University of Maine, Orono, Me.

MANY varieties of apples and pears for various reasons bear only every other year. This condition is not uniform the country over, but is more common in the fruit sections of the North and East than in the South or West. The same is true but to a less extent of the stone fruits. The causes are somewhat varied but are mostly the result of the climatic environment in which the trees are grown. The biennial bearing habit is apparently not an inheritable trait, but when it once becomes fixed in the life of the individual there is little that can be done to change it.

In the fruit sections where the climatic conditions favor the setting of a crop every year, the biennial habit does not exist. In those sections where frosts and rains interfere with the set of fruit, the life processes of the tree are thrown out of balance and the tree gets into the habit of over-working one year and recuperating the next. A normal tree develops fruit buds for the next year at the same time it is maturing the present crop. When there is no fruit to mature, an over supply of fruit buds is prepared for the next year. When the time comes, if conditions are favorable, a heavy crop sets and the tree puts forth all its efforts to mature it. This causes such a heavy drain upon the energy of the tree, that no fruit buds are formed for the next crop. After a few years the habit generally becomes fixed and the tree continues as a biennial bearer.

If the trees are properly pruned and the fruit thinned, while they are young the habit can be prevented to a large extent. When a heavy crop sets on a young tree, it should be thinned enough so it will not be overburdened and can develop fruit buds while maturing the crop. If frost destroys the blossoms, then the grower should reduce the vigor of the trees by cropping the orchard or by giving less cultivation. A heavy pruning in the years when a crop is expected will tend to reduce the amount of fruit and increase the wood growth. Early summer pruning during the crop year will often stimulate fruit buds. As the trees grow older the habit becomes fixed and it is hardly worth while to attempt to correct it.

That a heavy crop actually reduces the number of blossoms formed for the next year can readily be proved by observing and counting those that appear through two or three years. Instances are not uncommon, where scarcely a dozen blossoms developed on trees that matured a heavy crop of fruit the preceding year. In the particular case illustrated in the accompanying photograph, one-half of the tree had been grafted to a gravenstein while the other half was of the original variety. For some unaccountable reason each half of the tree chose opposite years for their heavy crop. In the spring it presents an odd appearance by one-half being in heavy bloom while the other half scarcely develops a single blossom. The next year the process is reversed.

This tree is now about 25 years old and to the writer's personal knowledge has behaved as described for

GRAVENSTEIN APPLE GRAFT ON A RUSSIAN TYPE

The arrow marks the point of union. This year the Gravenstein branch is loaded with blossoms while the rest of the tree is comparatively bare. On alternate years these conditions are reversed. (Fig. 3.)

the past five years. No certain explanation as to the original cause of the condition can be given. As there is some slight difference in the blooming time of the two halves, it is possible, that frost may have come at such a time as to destroy the fruit on one side while the other escaped. It is interesting for two reasons. First, that it indicates that the formation of fruit buds is not wholly a question of nutrition. Second, that the food supply of the tree is directed *first* to the needs of the maturing crop.

Country Versus City Boys—A Difference in Environment Shown to Be Without Effect on General Health

Professor O. C. Glaser of the University of Michigan calls attention[1] to an interesting comparison made from army statistics between the physical fitness of our city boys and those from the country districts:

"In order to determine whether the average of physical soundness is higher among country boys than among city boys, the following comparison was made: Selection was made of a typical set of cities of 40,000 to 500,000 population, with no large immigrant element, and distributed over ten different states (Alabama, Arkansas, California, Colorado, Kansas, Montana, Nebraska, New York, and South Carolina) and a corresponding set of counties of the same total size, located in the same states and containing no city of 30,000, the total number of registrants in the two areas being 315,000. The result of the comparison was as follows: Of 35,017 registrants in urban areas, 9,969 were rejected; of 44,462 registrants in rural areas, 12,543 were rejected, or 28.47% of the city boys and 27.96% of the country boys. The result, therefore, was practically a tie, showing that the country boy does not possess a greater degree of the physical soundness necessary for his acceptance as a soldier."

This is in a way an experiment in heredity. The science of eugenics should include experimental tests as to any measurable effects produced by a change in the environment. Such changes are technically known as "modifications." If two populations have the same average heredity and are subjected to diverse environments, any changes noted may be presumably referred to the actions of the differing environments. Two distinct populations can however rarely have the same heredity. Selections acting through migrations and through survival of the fittest make the inborn qualities of different populations necessarily dissimilar. Some forces in city life must have been favorable to the health of its growing manhood, some unfavorable; and the same may be said for life in the country. It might have been thought that, on the whole, the advantages of fresher air and a more simple routine would have shown itself in this test, and that the country boys would have won. These results do not of course mean that it is not a good idea, when one is ill or run down, to take a trip to the country. In many ways the change wrought upon the individual is immediate and lasting. What these figures do show is this—that there are and have been a great many diverse and complex factors back of our present civilization, our supposedly artificial, commercial or city life and that many of these must have been beneficial to our citizens. Here at least is a definite difference of environment unable to show a measurable modification.

In connection with question of physique a few additional comments may throw some light upon the matter. It has been found that city boys are more likely than country boys to reach, in after life, a high level of intellectual

[1] *Good Health*, August, 2, 1918, p. 463.

distinction.[2] This is probably in part due to superior urban opportunity, but no one knows whether the disadvantages may not outweigh the advantages. Whatever be the causes of the phenomenon it is certainly a fact in accordance with mental inheritance since it is perfectly well recognized that talented youth longs for the life of the metropolis and naturally migrates cityward, and this inflow improves the quality of urban germ plasm.

Also, whether they marry in the country or marry in the city, the wives of these young men, who become the mothers of the next generation, are probably above the average in mentality; and this also works, as far as mental standards are concerned, to the advantage of the urban and to the detriment of the rural districts. The expectation that the wives will be similar to their husbands rests upon statistical investigations, which prove that there is a tendency for like to mate with like.[3] The principle is spoken of as assortative mating. Whether it be stature, eye color, hair color, longevity, insanity, general health, truthfulness or intelligence, exact measurements show that a man and his wife, though not related by blood, actually resemble each other as much as do uncle and niece or first cousins. Also we may add that physical superiority is correlated with mental superiority, so here is another explanation of why our city registrants made such a good showing in these recent army statistics.

The Testing of Pure-Bred Cows in New South Wales

A stud dairy sire should be pure-bred, of good type and constitution, but not every pure-bred sire is descended from ancestresses that were capable of yielding large quantities of milk and butter-fat, and, further, not all are capable of getting stock that possess these dairy qualities. These productive traits are hereditary, and one of the principal things expected from the testing of our stud stock is the defining of those families in which this factor is strong and dominant. So far, with only four years' records to refer to, our quest in this direction is limited, but the knowledge already in our possession encourages the hope that with the continuance of testing these families will be as well known in a few more years as those from which spring our famous race-horses. When this is established the dairy herds, not only of this State but of Australasia, can be bred up on proper production lines, and the prospect of their yields being doubled brought much nearer realization.

REVIEW OF THE YEAR'S WORK

The figures for the work of previous years have been taken from the annual reports of the Department of Agriculture, of New South Wales, which are made up to the 30th June of each year. The following tables for twelve months ended 30th June, 1916 and 1917 respectively, will show how those two periods compare (see appendix).

It will be seen from the foregoing that increased productiveness was made in all cases, except that of the milking shorthorn, which breed showed a very slight decrease. The average increase was 65 pound butter (20%) and 2,032 pound milk (25.5%). While the number of cows undergoing test was greater in 1917 by sixty-four, the number to complete the 273 days period was less by thirty than at the 30th June, 1916. —L. T. MacInnes, in *Farmers Bulletin* No. 117, Department of Agriculture, New South Wales.

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[2] See Woods, Frederick Adams, *Science*, April 9 and July 2, 1909.
[3] See Popenoe, Paul, *Applied Eugenics*, N. Y., 1918, p. 126 and Chapter XI.

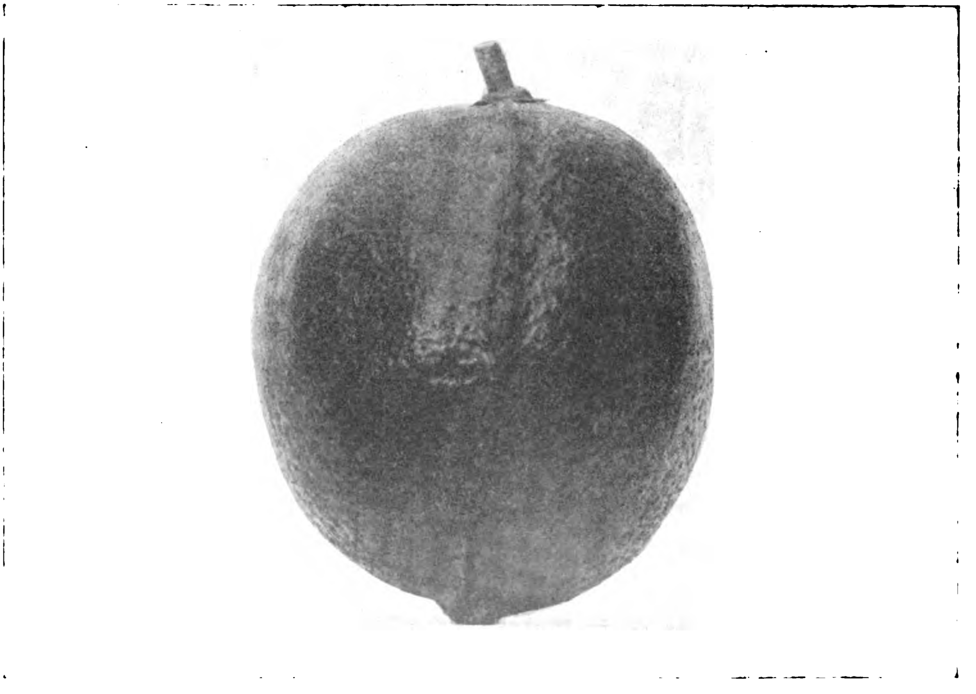
ORANGE LIKE FRUIT FROM A LEMON TREE

GIZA MUDIRIEH, EGYPT,
May 20, 1918.

DEAR SIR:

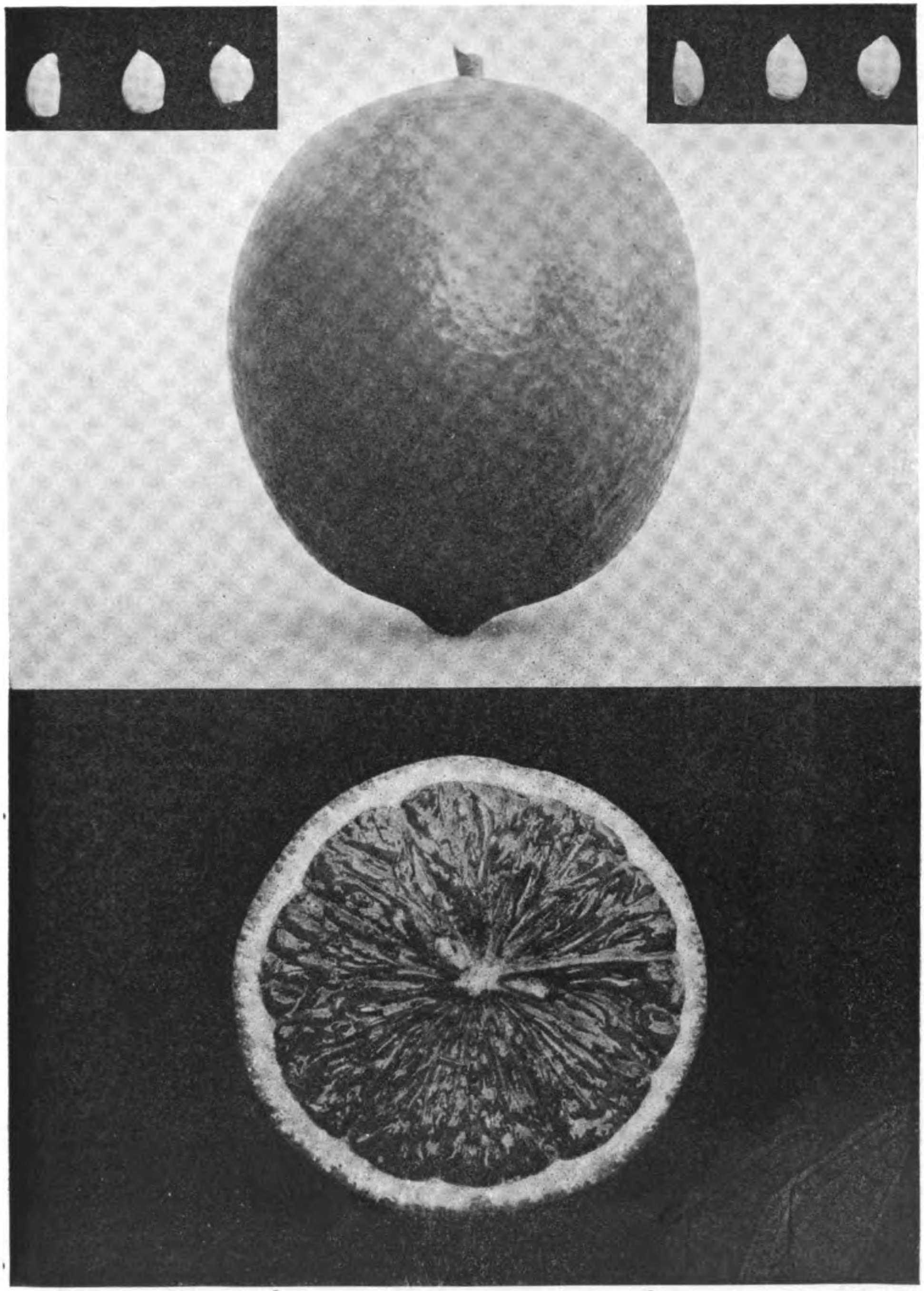
I enclose herewith three photographs of fruit taken from one tree. The tree was received from Italy and planted in the gardens of the Ministry of Agriculture at Giza, Cairo. It was supposed to be a typical Italian lemon. In the spring of 1917, it bore an excellent crop of fruit. Instead of the fruit being that of the ordinary lemon, it proved to be more spherical in shape, as shown in Fig. 5. The color of the fruits was that of a lemon, but many of them were characterized by a raised longtitudinal orange-colored line on one side. This is shown in Fig. 4. Upon one of the branches appeared a large fruit which resembled a large orange in appearance and in taste. This is shown in Fig. 6. There is no question of the branch which bore the orange fruit having arisen from an additional graft. Several twigs of the same branch bore lemon fruits, such as those shown in Figs. 4 and 5. The tree itself is a grafted tree, but evidently the buds employed in its propagation had been taken from a hybrid tree between an orange and a lemon. I send this information in case it is of interest to you.

Yours faithfully,
THOS. W. BROWN.



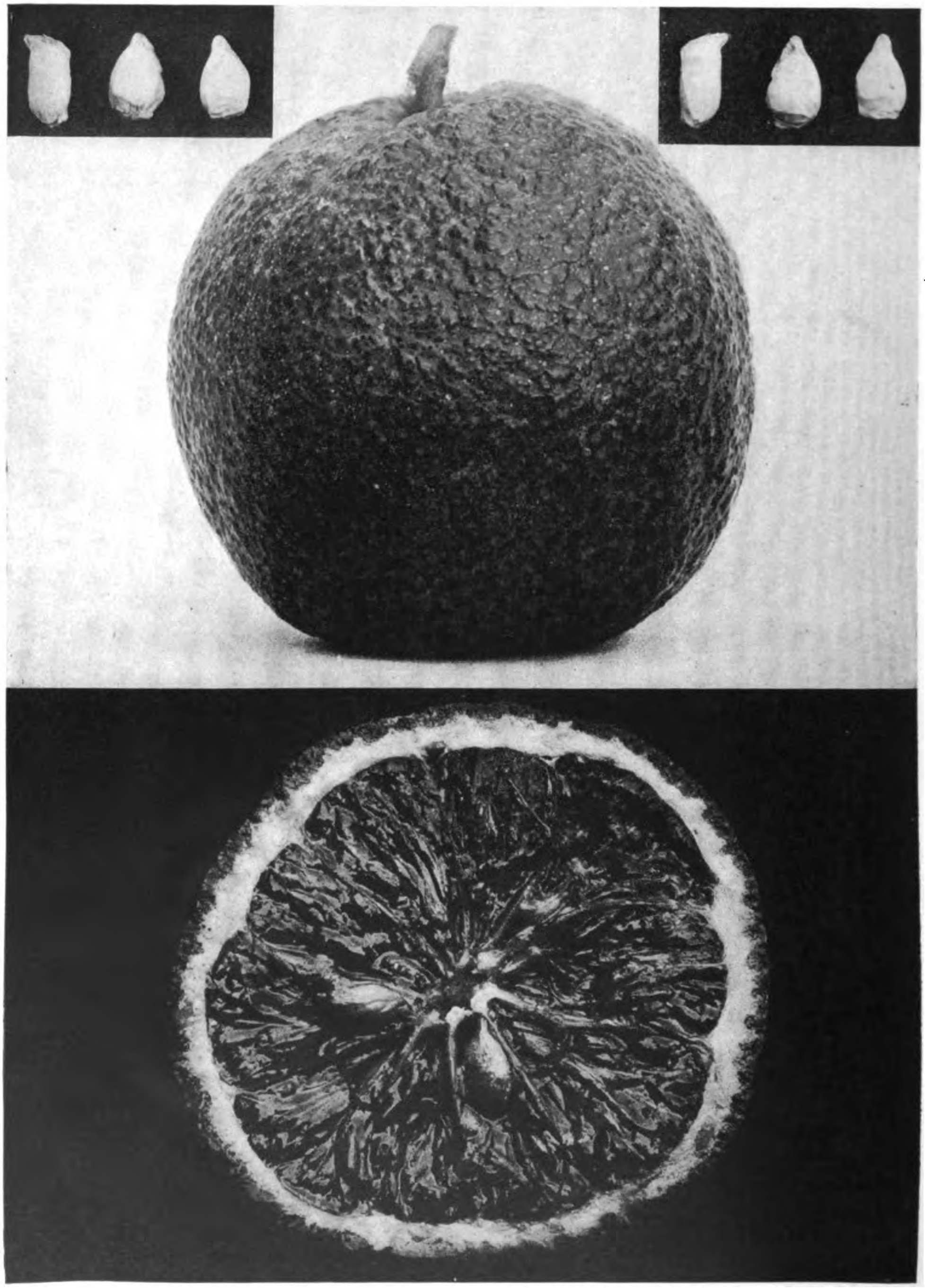
FRUIT GROWN ON A TREE SUPPOSED TO BE A LEMON

Raised orange-colored line on one side longitudinal to the fruit. (Fig. 4.)



PECULIAR LEMON IN PART RESEMBLING AN ORANGE

The color was that of a lemon, but the fruit had a more rounded contour. Grown in the gardens of the Minister of Agriculture at Giza, Cairo, on a tree supposed to be a typical Italian lemon. (Fig. 5.)



ORANGE IN TASTE AND APPEARANCE

Grown in the gardens of the Minister of Agriculture at Giza, Cairo, on a tree supposed to be a typical Italian lemor. (Fig. 6.)

STANDARDIZED TESTS AND MENTAL INHERITANCE

Very Young Children Already Show Great Variation in Special Aptitudes—These Differences Are Probably Not to Be Accounted for by Differences in Environment—More Tests Needed

JUNE E. DOWNEY, PH.D.

Professor of Psychology, University of Wyoming, Laramie, Wyoming

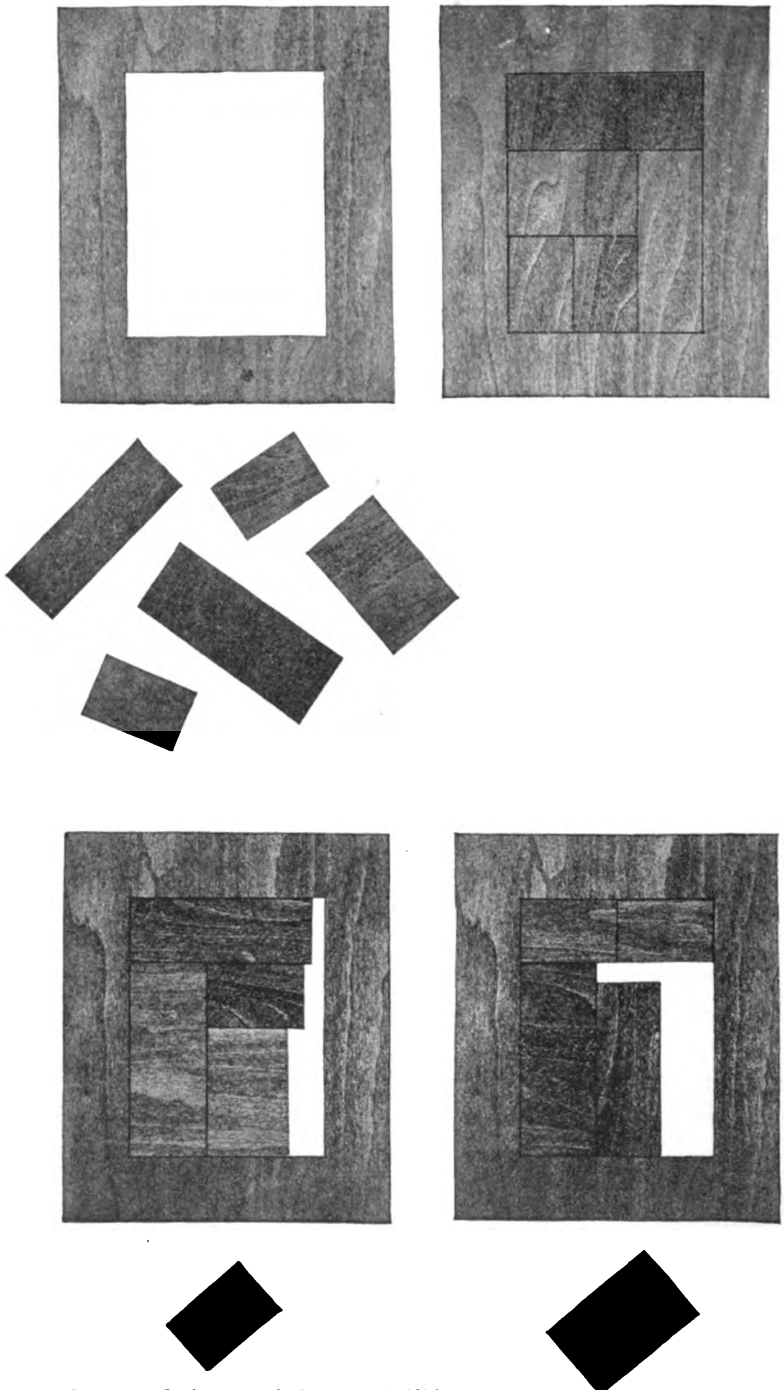
THE development by psychology of standardized tests of mental capacity and the establishment of norms of performance for different ages has, among its other possibilities, opened the way for exact studies of mental inheritance. Goddard's utilization of the Binet Scale of Intelligence in establishing the heritableness of feeble-mindedness as a Mendelian recessive is but the first breaking of ground. Other suggestions of profitable investigation crowd upon the attention. For instance, the possible identification, by help of the scales, of carriers of mental defects and pure normals. Probably these two types will show significant differences in their reactions to standardized mental tests and they can in this way be differentiated from one another for eugenic purposes—a most desirable thing.

Again, the study of the supernormal child is incomplete unless we have some means of determining the kinds of mating that produce such progeny. With the accumulation of data incident to the very extensive intelligence testing which is now being carried on, material will be at hand for the formulation of the laws governing the transmission of degrees of general intelligence. Certainly it is significant that of groups of parents and children recently tested by my pupils the combination of parents, both of whom made a record of superior mentality by the Stanford adult scale, gave 80% of children making a superior or very superior record; while when only one parent gave a superior record or both made only an average one, the percentage of superior children was only 33. Our groups were too small to permit our drawing any dogmatic conclusions, but they certainly encourage further investigation.

Another utilization of standardized tests consists in such early determination of special capacity as eliminates the possibility of the gift in question, being the outcome of a peculiarly favorable environment. Every investigator of mental inheritance encounters a difficulty in distinguishing between environmental and congenital factors. The proof that a capacity above the average was manifest at too early an age to permit accounting for it on the ground of training, stamps that capacity as congenital and, probably, as germinal. In spectacular cases of genius, musical and mathematical prodigies, for instance, the general public has not been blind to the bearing of the facts upon the theory of original capacity, but when talent of low degree or specialized ability of any sort is in question the inference of its inheritance has seemed less inevitable. Only the employment of norms, which give us the range of performance for various ages, can enable us to identify with confidence a native capacity at a very early age. My records on children show a number of very interesting instances of the kind in question.

SENSING WEIGHTS

Cases I and II. The children concerned, Bertha C. (age nine years two months), and Clifford C. (age six years



Courtesy of Little, Brown & Company, Publishers

HEALY-FERNALD CONSTRUCTION TEST A FOR INTELLIGENCE

An example of a test which demonstrates planfulness and the powers of learning by experience. The illustration shows the test as presented (upper left), as completed (upper right), and two types of error.—From *Healy's Individual Delinquent.* (Fig. 7.)

five months), are half-brother and sister, and so far as general intelligence is concerned, low average. Their social level would be described as inferior. Both showed, however, when tested by the Standard Revision of the Binet Scale, unusual keenness in discrimination of differences in weight. This was evident not only by their passing of the tests on weight discrimination, but also by their method of procedure. Bertha, for example, retained after her first serial arrangement of five weights such a clear-cut memory of the weight of each block as to be able to place them thereafter in sequence without intercomparison. Her ability to do this, after a preliminary handling, was checked many times. Squares were chalked on a table and she was instructed to place each block in its proper square as soon as she had lifted it. Her threshold for weight discrimination when determined by the standard tests proved to be extremely low for a child of her age. Clifford, her brother, reacted in much the same way when tested with two weights, according to the five-year procedure. Moreover, after a little practice with the blocks, he was able to arrange five in sequence (a nine-year test) by the same method as his sister, namely, an absolute sensing of the weight. It is probable that in other respects also these children possess keen sense discrimination, as when the weight test was tried on a table without our usual velvet cover, Bertha was quick to identify the blocks by their sound in striking the table. Later, on interviewing the mother of these children, we found that their maternal grandfather had, as postmaster, enjoyed a reputation of being able "to tell" the weight of articles without using a scale. The mother reports that she herself does not possess the gift.

Case III.—Virginia F. At the age of two and a half years (1910) Virginia surprised her relatives by a passionate interest in a set of blocks that could be put together to form six different pictures. At that time picture-puzzles had not been exploited as a means of testing a child's development, and careful notes of Virginia's performance were not recorded. Her interest, however, was very evident, and her skill in manipulation seemed extraordinary; she early devised a scheme for rapidly shifting from one picture to another by making such a number of turns per block as was necessary to place it in the new picture.

JUVENILE CAPACITIES

At the age of three years six months, Virginia was put through the 1908 Binet test, making a mental age between four and a half and five years by that scale. My interest was centered largely in the general outcome and I failed to notice significant features of the result. At nine years six months, Virginia was given the Stanford Revision of the Binet Scale and made a mental age of ten years six months. The fact that in spite of her high intelligence quotient she was only "at age" in her school work led to a careful scrutiny of her record. It was evident that her failures to score under the age of eleven were all in verbal tests. She was hesitant in defining words—an actual retardation in readiness of expression and not in comprehension, as she succeeded in the fable test for twelve years and the dissected sentence and similarity test for the same years. Turning back to her record at three and a half years, I find that at that time also, inspite of a very superior performance in other respects, she gave only the infantile form of definition, and that only under pressure. But at that time she knew her right from her left hand, a six-year test, and at nine and a half she manipulates the well-known Healy-Fernald Construction Puzzle A in 20, 18, and 12 seconds for three trials, respectively, although the performance of the average ten-year-old is scheduled at three times in five minutes (Fig. 7). In order to test further her capacity in dealing with form-boards, I put Virginia through the Pintner-Patterson scale of performance tests. Her record on the boards, where ease in spatial orientation is a factor of importance, was extremely

good. By the percentile method of scoring she is found to rank among the best ten or twenty of one hundred children of the same age, for the particular tests under discussion. Such capacity involves nothing spectacular, and is, therefore, of the more value in demonstration of the minuteness with which native traits may be parcelled out. The especial point of interest is the revelation of this capacity in the very early play of the child. It is probable that Virginia inherits her skill in spatial orientation from the paternal side, as her relatives on her mother's side are very deficient in this capacity. At nine years Virginia is absurdly more apt at form-boards than her maternal aunts. She is also much readier than her small brother and sister.

UNIDEXTRALITY

In studying unidextrality and its complications, I have had recourse to comparative measurements of the right and left arms, using Dr. Jones' brachiometer, which has been devised for just this purpose. Virginia shows greater excess of difference in length between the right and left arm than does either of the other children. This I anticipated, since, according to a theory upon which I am at present working, skill in handling spatial relationships is, in part at least, a function of a high degree of unidextrality.

Case IV is that of a very superior child, John H., who, at four years eight months, has a mental age of over six years. But his record in repeating digits after the examiner in both natural and reversed order outstrips his other reactions, since his performance is that of a ten-year-old child. This capacity is shared by a brother, a year older, and is exhibited also by adult members of the family.

Case V.—Paul S., at eight years, possesses a mental age of ten; his vocabulary record, however, is that of the twelve-year-old child. His gift in this direction was evident at two years, at which time a list of the words used within a prescribed time totaled 711, with an estimate of 750 as his actual vocabulary. This is a very remarkable record, as shown by a comparison with other vocabularies reported for children of the same age. Paul's environment is undoubtedly a very favorable one for development of this gift, but only native capacity can explain the fact that his two-year record surpasses that of other children in the same family.

The instances cited above are very simple ones, and no doubt could be easily duplicated. They are, for that very reason, perhaps, more convincing in their bearing upon the all-pervasive quality of mental heredity. Certainly, most psychologists are keenly alive to the big problems involved in mental inheritance and anxious to determine the limits set to training by mental capacity.

"Psychobiology"

A New Publication of Interest to Biologists

Psychobiology will include research on problems which involve mental or conscious factors as details in the total functioning of the organism, as well as biological and physiological researches which contribute to our knowledge of mental function. The topics included will naturally cover a wide range in other respects: problems of psychobiological importance are involved in the study of the sense organs and reactive mechanisms; of inheritance; of pathological and operative conditions of the nervous system; of the thought processes; of emotional experiences; of drug effects and of many other topics. Reports of research on the lower animals will be included in so far as they fall within the field of psychobiology.

The journal is edited by Professor Knight Dunlap of Johns Hopkins University. The subscription price for the United States is $5.00 a volume. Williams and Wilkins Company, 2419-2421 Greenmount Ave., Baltimore, U. S. A.

A FRUITING ORANGE THORN

Thorns Are Modified Leaves or Branches. On Orange Trees They Are Nuisances. Thornless Variety May Be Produced

A. D. Shamel and C. S. Pomeroy

THE Century Dictionary defines a thorn as "a sharp excrescence on a plant: usually a branch or the termination of a stem or branch, indurated, leafless, and attentuated to a point." Botanically speaking, thorns are modified leaves or branches.

A striking illustration of the relationship of some thorns to branches is shown in the accompanying figures. These show the development of abnormally large thorns on rapidly growing branches of the Washington Navel Orange (*Citrus sinensis* (L.) Osbeck). Some of the thorns have developed into branches bearing fruit, leaves and secondary thorns. These varying stages of development illustrate the fact that, in the citrus, thorns are truly modified branches. (Figs. 8 and 9.)

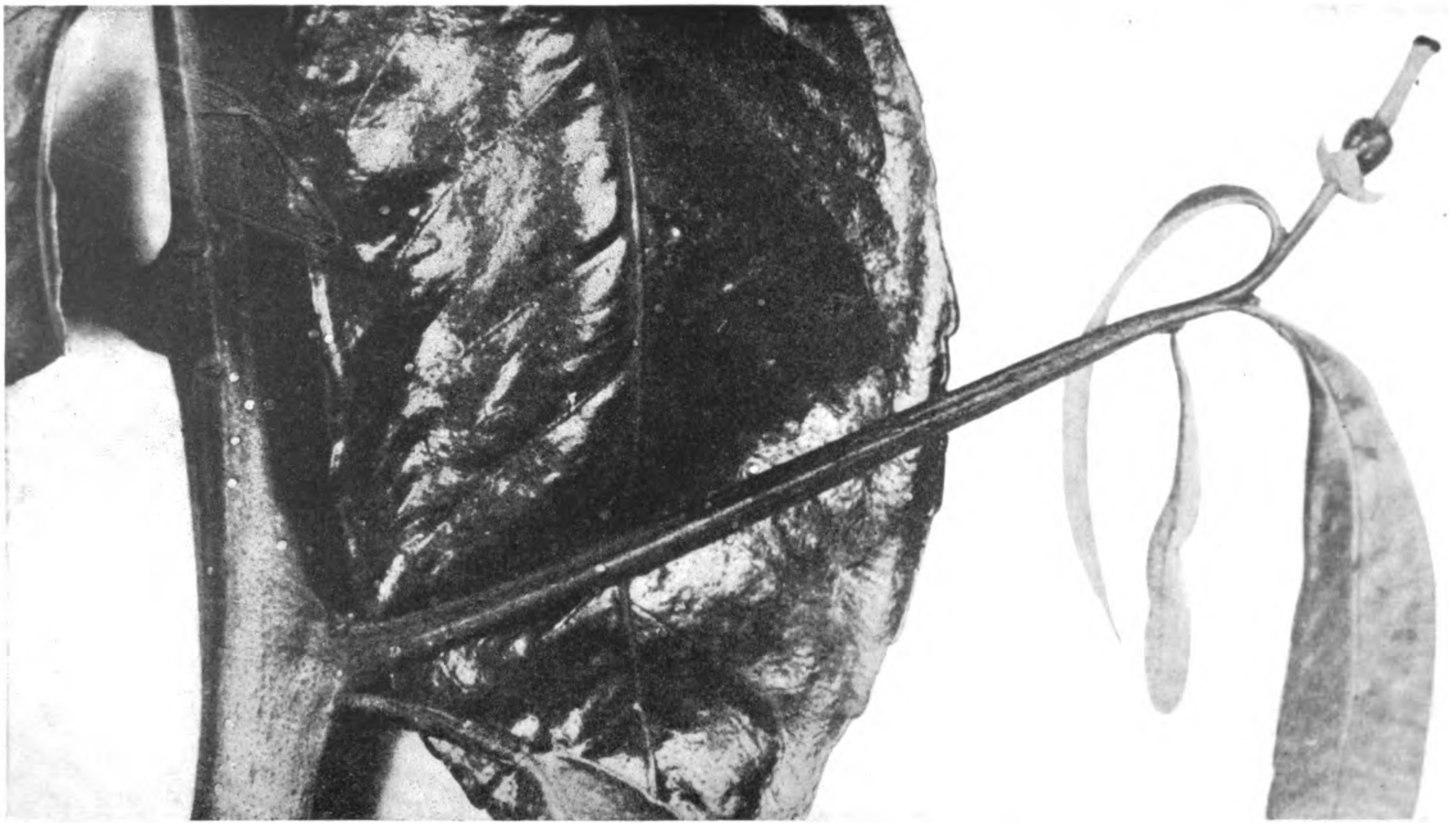
THORN BEARS AN ORANGE

As can be seen in the illustration, one of the thorns bears a small orange. The young navel orange is borne at the tip of the thorn which also bears several small leaves and behaves like a fruiting branch of a navel orange tree.

Thorns in citrus trees, in cultivated orchards, are nuisances. They interfere with the work of picking the fruit, in that they are likely to injure the unprotected hands and arms of the pickers. Instances are known where citrus pickers have suffered serious injuries from thorns, resulting in the loss of fingers, hands and eyes. Furthermore, the thorns are undesirable, as they frequently puncture the nearby fruits. These punctures offer opportunities for the entrance of various fungus diseases which often result in decay and loss of fruit. This decay may take place on the tree, but more frequently occurs after the fruits have been packed for the market. For these and other reasons citrus propagators and breeders have endeavored to propagate thornless strains.

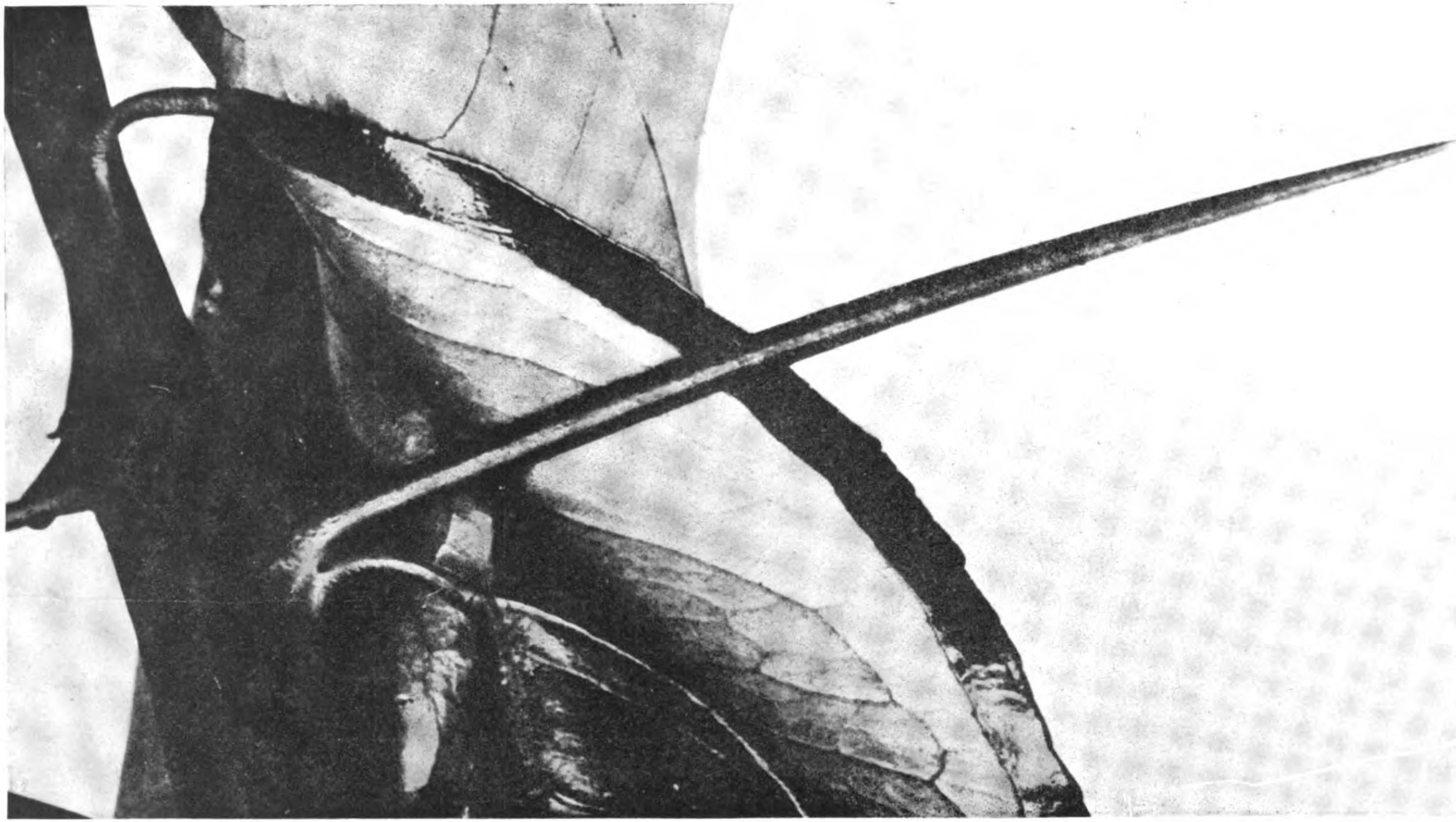
It is a well-known fact that the size and number of thorns vary on the different trees of a variety and often on the different branches of the same tree. Through the selection of buds for propagation from thornless limbs, or those having small thorns, considerable progress has been made in isolating thornless strains, or strains in which the trees produce few and no thorns.

The variation of thorns in the citrus varieties, and in the strains of the same variety, is convincing evidence as to the heredity of this tree characteristic. The variation in thorniness on the trees of the same strain furnishes a basis for the isolation of thornless strains through systematic bud selection.



AN ORANGE THORN THAT BORE AN ORANGE

This orange thorn bears a young navel orange as well as several small leaves. It illustates the fact that thorns may be merely modified branches. (Fig. 8.)



AN ORANGE THORN WHICH IS A NUISANCE

Instances are known where citrus pickers have suffered serious injuries from thorns, resulting in the loss of fingers, hands and eyes. Furthermore, thorns frequently puncture fruits and favor decay. Thornless varieties are desiderata. (Fig. 9.)

TYPICAL LEMON TREE FROM SELECTED BUD

A typical Lisbon lemon tree about 10 years old in the Shippey orchard grown from a bud selected from a productive and desirable parent tree. (Fig. 10.)

LEMON ORCHARD FROM BUDS OF SINGLE SELECTED TREE

Remarkable Uniformity of Fruit Compared with Those from Ordinary Lemon Orchard from Miscellaneous Buds

A. D. Shamel, *Riverside, Cal.*

THERE exists in California several citrus orchards in each of which the trees are known to have been propagated from buds selected from a single particularly productive and desirable parent tree.

The trees in the Shippey Lisbon lemon orchard of forty acreas, located four miles north of Porterville, Cal., were all grown from buds secured from a very productive and valuable parent tree. Two thousand trees were planted in this orchard. Owing to a root-rot disease 300 trees have died, so that, at the present time 1,700 trees survive.

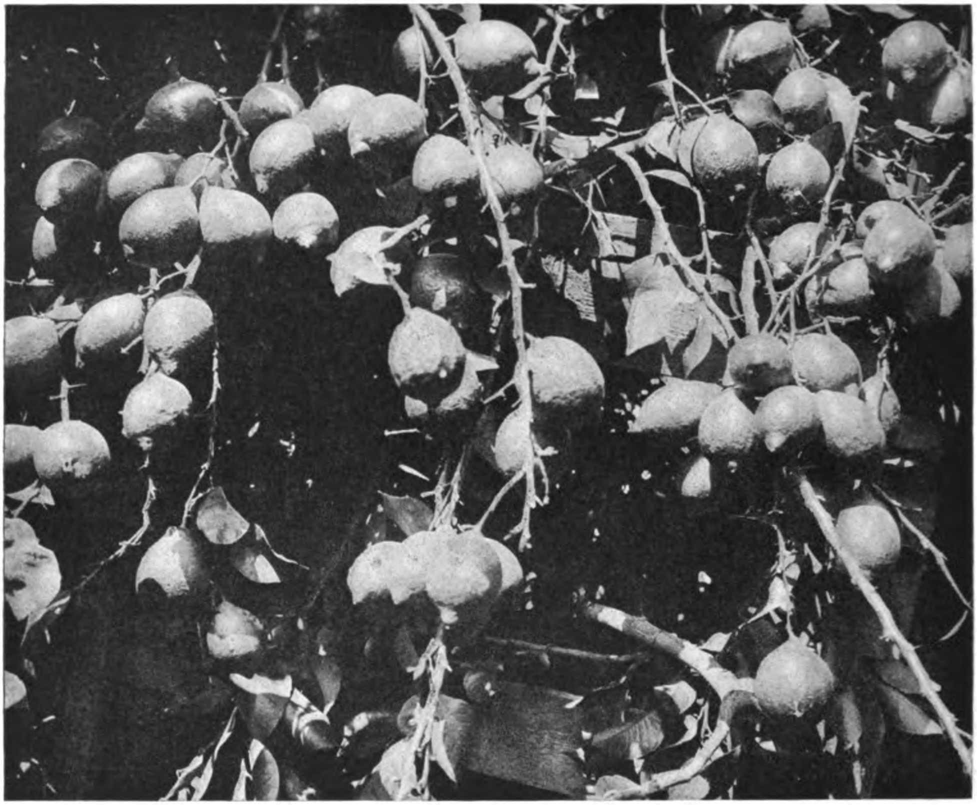
The parent tree, located in the Buswell orchard near Porterville, produced, in 1902, 1903, and 1904, yields of 24, 26, and 28 picking boxes of lemons, respectively. Each of the picking boxes contained about 60 pounds of fruit. In 1905 enough buds were cut from this tree to bud 2,000 sweet orange stocks, or, in other words, to propagate enough trees for the forty-acre orchard.

The young trees were grown in the nursery about two years. They were set out in the orchard in 1907. They were arranged in squares 29½ by 29½ feet apart. Fifty trees were planted on each acre.

NO OFF-STRAIN TREES FOUND

A recent study of this orchard by the writer, after the trees had been planted about ten years, revealed a remarkable uniformity in the type of the trees. They all were found to belong to the productive Lisbon strain. Not one off-strain tree was discovered. Some variation in tree characteristics within the strain was found upon close examination. However, to trained observers the uniformity of the trees in all apparent characteristics was truly striking and emphatic. A comparison of the uniformity of the trees in this orchard with the trees of other orchards of the same variety and about the same age, where ordinary methods of securing budwood had been practiced, showed that the trees in this orchard were more uniformly good than those in the other orchards. In Lisbon orcharts where no bud selection, based on performance records and intimate tree knowledge, had been practiced in propagation, it was found that from 10 to 70% of the trees were of variable or off-type strains. In the Shippey orchard not one such tree was found.

The yields shown in this table are much greater than is ordinarily the case. It may also be said that the behavior of these trees is very much like that of others which have been more recently grown from buds secured from parent trees selected on the basis of their performance records and intimate tree knowledge. For this and other reasons, the writer and others believe that the uniformly early and high production of good fruits in the Shippey orchard is largely due to bud selection.



LEMONS AS THEY ARE PRODUCED IN THE SELECTED SHIPPEY ORCHARD

Lisbon lemons produced by the tree shown in Fig. 11 and showing uniformly good fruit characteristics. (Fig.11.)

PRODUCTION OF THE SHIPPEY LISBON LEMON ORCHARD

Years planted	Total yield in terms of number of packed boxes of about 90 lbs. each	Average yield per tree in terms of number of packed boxes of about 90 lbs. each	Number of trees	Notes
2	16	....	2,000	
3	1,174	0.58	2,000	
4	2,687	1.49	1,800	Loss of trees due to root-rot, probably due to too much water.
5	5,213	2.89	1,800	The grove paid for itself at the end of the fifth year.
6	Frozen			
7	7,477	4.15	1,800	
8	8,528	4.87	1,750	
9	7,859	4.62	1,700	About 4,000 packed boxes lost by frost. Total average per tree 6.97 packed boxes.

HOW SORGHUM CROSSES ARE MADE

T. E. Nafziger

THE sorghum heads which are not to be used for crossing, should either be bagged, or should be entirely removed from the stalks before their anthers open. This prevents pollen from these heads from falling upon the flowers of the experimental plants before the emasculation [removal of stamens] of their flowers or while the process of emasculation is taking place.

A branch or "ray" is selected from a panicle [flower cluster] of a plant of a pure strain, which has none of the anthers or stigmas exposed. The blossoms must be emasculated before the anthers emerge. Care must be taken however, not to open the blossoms while in their earlly stages of formation, as injury may result to the interior, causing the pistils and the glumes [corresponding to petals in ordinary flowers] to dry up.

A BLUNT NEEDLE MAKES A GOOD TOOL

In emasculating the blossoms, an instrument should be used that is not so sharp as to puncture the anthers, and yet not so blunt as to mutilate the interior of the flower. A steel dissecting needle with the point slightly blunted, can be employed with a fair degree of success in removing the stamens. A common pin could be used, were it not for the slight possible chance of injury to the flower due to the material used in the construction of the pin.

All of the flowers on the branch chosen, except ten or a dozen, are then carefully removed from the branch. These remaining flowers are emasculated by prying the glumes apart very carefully with the dissecting needle. Placing the needle under the three stamens, they are removed one by one from the interior of the flower. If an anther has been punctured during the process of removal, or if the hands have been in contact with punctured anthers, the hands and the needle should be washed in alcohol, and allowed to dry thoroughly before proceeding with the work.

The branch is bagged, after the flowers are emasculated, with a small paraffined paper bag, to prevent pollen from reaching the stigmas of the emasculated flowers. The panicle which has the attached branch, is also bagged (preferably with a waxed bag) to save the pollen for the reciprocal cross. The panicle is then tagged with a label showing the number of the strain, the number of the plant, the number of the reciprocal, and the date when emasculation was done. A representative tag is reproduced in the figure below.

N+1 ♀
×
N_1+1 ♂
Date

N = strain number (female).
1 = plant.
N_1 = strain number upon which the cross is made (male).

The same procedure as outlined above, is followed in emasculating the flowers of the strain upon which the reciprocal cross is to be made. The tag on the panicle of the reciprocal would show the following.

N_1+1 ♀
×
N 1 ♂
Date

The first line in the notation on the tag indicates that the tagged plant is the female N_1 and that N is the male plant.

The time elapsing between emasculation and pollination depends upon weather conditions. Ordinarily, the time is about seventy-two hours. The pollen is transferred to the stigmas with a small brush, directly from the bag in which it has collected. The pollinated ray, and the panicle are again properly bagged. In forty-eight hours the bag may be removed from the former.

The milos [a type of sorghum] have proven to be the most difficult to cross, the flowers appearing to dry up, shortly after emasculation takes place. When an anther is punctured during the process of emasculation, the affected flower should be removed from the ray. Too much pollen should not be placed upon the stigmas.

If all the panicles are bagged, thus preventing the pollen from blowing about, the bags may be removed from the rays after each day's work of pollination is completed. The stamens do not emerge during the heat of the day, but emerge freely during the night.

The work herein described was carried on by the writer on the plant breeding plots of the Department of Botany and Plant Breeding, of the Kansas State Agricultural College, during the summer of 1916, under the direction of Professor H. F. Roberts.

Training Little Children for the New Life

Congress has recently recognized the educational needs of little children by making an appropriation to the United States Bureau of Education, to enable it to promote kindergarten education in the several states and territories.

This act is timely, for our people are being rudely awakened to the need of better training for citizenship than our boys and girls are now receiving. They realize the urgent necessity of properly equipping our children for the tremendous tasks they will be called upon to perform after the war is ended.

The Council for National Defense states that there are nearly 4,000,000 children in the United States who can not receive the benefits of kindergarten training either because there are no kindergartens at all or not enough.

Training for citizenship cannot begin too early according to the United States Commissioner of Education, who for months has been issuing, in cooperation with the National Kindergarten Association the series of articles which this paper is printing, to provide better training for little ones in the home.

A drive is now on to have more kindergartens opened throughout the country and parents are circulating petitions to present to their boards of education. The General Federation of Women's Clubs, the National Congress of Mothers and Parent Teacher Associations, Suffrage and labor organizations are all deeply interested in this subject and great hopes are entertained that the drive will receive the hearty cooperation of local school authorities thoroughout the country.

PROLIFICATION IN A DOUBLE-FLOWERED FORM OF CALENDULA OFFICINALIS

Extremely Rare Development of Multiple Buds in Pot Marigold

PETER BISSET

Plant Introducer, U. S. Department of Agriculture.

PROLIFICATION is a word often used by horticulturists to denote a departure from the ordinary method of flowering of cultivated plants. It is used generally where more flower buds are produced than is commonly the rule, and especially so when they appear where ordinarily they would not, as in the present instance, where a number of flower buds were developed from one normal flower head.

Although prolification is not uncommon in some double-flowered plants, the writer has never before seen this occurrence in the Calendula.

These plants were grown in the spring of 1918, at Twin Oaks, Washington, D. C., by Mr. E. G. Anderson, who is superintendent for Mr. Charles J. Bell. My attention was attracted to the strange behavior of several of the flowers; the central flower was apparently normal, but before it was fully developed several buds were produced—some from the center of the flower (see Fig. 12). These developed into flowers and opened fully, although not as large as the first; these later, in several instances again produced buds that developed flowers, they, in turn, not as large as the second tier (Fig. 13).

I left at about this time for the West and therefore did not see the final stages of these flowers, but asked Mr. Anderson to save any seed that might mature so that we could try another experiment to determine if this prolification would become fixed. Unfortunately no seed developed, and the plants, being annuals, were necessarily lost.

This form of prolification often occurs in the double-flowered English daisy, and in England has received the common and expressive name of the Hen-and-Chicken Daisy. Prolification also frequently occurs among our common roses. In the rose, however, it often takes the form of the prolonged flower stalk coming up from the center of the parent flower, often producing leaves and then a bud which develops later into a flower.

The Calendula plants, here shown, were grown in a greenhouse bench in rather rich soil and where they were given the best of care as regards watering, temperature, fertilization, etc.—in fact, ideal conditions for the best development of normal flowers. It might be asked, were the conditions conducive to the production of such prolified flowers as were borne by several of the plants. I am inclined to think that this was the case, and that they were over-stimulated.

POT MARIGOLD PROLIFICATION

Pot marigold (*Calendula officinalis*), showing the flower head, with buds and flowers. Many flower buds are in the course of development in the central or main flower, and can be seen in the illustration. (Fig. 12.)

POT MARIGOLD PROLIFICATION

Pot marigold (*Calendula officinalis*) showing the flower prolification further developed. The outer or secondary flowers shown here produced later other tiers of flowers not shown in the illustration. (Fig. 13.)

NATURAL CROSSING IN WHEAT[1]

A Cause of Impurities in Breeding Plots—Belief of Some Agronomists that Hybrids Frequently Revert to the Parental Type

H. K. Hayes

Minnesota Agricultural Experiment Station

Some difference of opinion exists among plant breeders as to the frequency of natural crossing in wheat, some contending that such crosses rarely, if ever, occur, while others believe that natural crosses are comparatively frequent. Botanists do not all agree regarding this question; for Robbins[2] states that durum wheats have the habit of cross pollination, and also states that cross pollination appears to be the rule in hot, dry countries, as in certain parts of India, while in the northern, wet climates close pollination is the rule. On the other hand, Früwirth cites Körnicke as an authority for the statement that self-fertilization is by far more prevalent, but cross pollination is possible in *T. vulgare, T. durum, T. dicoccum*, and *T. spelta*.[3]

As this subject is of much importance to wheat breeders, and also of interest to crop experts and farmers who are desirous of producing pure seed, a note as to the frequency of natural crossing at University Farm may be of some general interest. For a fairly complete summary of literature on this subject the reader is referred to a literature review by Pope (previous citation).

FREQUENCY OF NATURAL CROSSES AT UNIVERSITY FARM

The evidence here given is believed to be about as complete as circumstantial evidence can be. In order to appreciate it, a knowledge is necessary of the behavior in crosses of a few simple differential wheat characters. These facts are well known by wheat breeders who have made artificial crosses.

Varieties commonly grown in the Northwest may be placed in two groups:

Group 1.—The so-called awnless wheats, as Marquis and the Bluestem varieties. These have very short awns on the upper spikelets.

Group 2.—Bearded sorts, such as Preston, Arnautka, Kubanka, and Turkey (winter).

Crosses between such bearded and awnless varieties give heads with intermediate awns on the tip of the head, and shorter awns on some spikelets from the middle to upper part of the head. In F_2 a ratio of 1 awnless, 2 F_1 types to 1 bearded is generally obtained. There is some difficulty in separating a homozygous awnless from an F_1 between awnless and bearded, but the separation is very easy between an F_1 and the bearded sort.

A cross between a hairy chaffed variety, as Bluestem, and a smooth chaff, as Marquis, has hairy chaff in F_1 and in F_2, 3 hairy to 1 smooth is the expected result. A hairy chaffed plant in a row of Marquis or other smooth chaffed variety is therefore easily determined.

Indications of natural crossing were observed in 1916 and 1917 in the nursery wheat plots at University Farm, and the conclusion was drawn that nat-

[1] Published with the approval of the Director as Paper No. 137 of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] Robbins, W. W. The Botany of Crop Plants. Philadelphia, 1917.

[3] Pope, M. N. The Mode of Pollination in Some Farm Crops. *Jour. Amer. Soc. Agron.*, Vol. 8, 1916, pp. 209-227.

NATURAL CROSSES AND PURE TYPES OF WHEAT

1. At right, head of a pure variety segregated from a cross between Turkey (winter) and a Fife. At left, a natural hybrid between this variety and Bluestem which was found in a row grown from an individual plant.
2. Pure type of Preston at right and natural hybrid at left. One such cross was found in a row of forty plants all of which were the progeny of a single plant selected the previous year. (Fig. 14.)

ural crossing in wheat was more common in the Northwest than had formerly been supposed to be the case, or that the seasons of 1915 and 1916 were very favorable for cross pollination.[4] The results here reported show that in 1917 there was also considerable natural crossing.

The plan has been followed of growing a purity plot of 50 to 100 plants each year of those selections and crosses which are being tested for yield in the rod rows. In these purity plots each plant is individually spaced and each plot is grown from a single plant selected at random from the previous year's purity plot.

In 1917 rows of Haynes Bluestem, an awnless, hairy chaffed wheat, were grown alternately with the purity plots. Individual plants for 1918 planting were selected in each purity row as usual. In 1918 these purity rows were carefully examined, and those crosses which could be determined were noted. The number of such crosses is given in the table in the appendix (page 334).

Aside from these, which were grown near Bluestem the preceding year, there were 49 other spring wheat plots grown from individual plants. Four thousand was the approximate number of plants examined in these 49 plots. Nineteen plants, which were F_1 crosses were observed. The rod row plots were also examined in both the spring and winter wheat nurseries. No crosses were noted in the durum rows, of which 24 were grown. Approximately 400 rod rows of spring wheat (*T. vulgare*) were examined, and 52 plants were found which were believed to be the result of natural crosses. Only such crosses as could be accurately determined were counted.

In the winter wheat nursery the purity rows were almost entirely winter killed. Between 600 and 800 rod rows were examined, and over 100 plants were observed which were believed to be F_1 crosses. Many absolutely clear cases were found; for example, plants with intermediate awns in bearded varieties belonging to the Crimean group. A number of such plants were found in rows of Turkey pure-line varieties obtained from Mr. Burnett, of the Ames Experiment Station. The crosses were noted the second season that they were grown at University Farm.

Observed crosses in Triticum vulgare lines average 1.3%, and the conclusion is certainly reasonable that cross pollination occurred as often between plants of the same variety as between different sorts. This would mean that natural crossing in 1917 was at least 2% to 3%.

NATURAL CROSSES AS A DIFFICULTY IN PURIFYING HYBRIDS

Among the sorts which have been tested for yield in the spring-wheat nursery are several crosses between Turkey (winter) and a Fife variety. These crosses were made many years ago, and are now comparatively pure. In 1915 some hairy chaffed intermediate awned wheats were noted in the rod rows of these crosses. An attempt was made to rogue these out, and in 1916 several plots of each of these sorts were grown from individual plants. These all apparently bred true, but when they were again placed in rod rows in 1917 there were again a few off-type plants, and many of these were clearly F_1 crosses. Unless these had been carefully studied, the natural conclusion would have been that this wheat could not be bred true. A few such F_1 plants overlooked may be a cause of much greater mixture the following year. Results of this nature are believed to be a logical explanation of the cause for the belief of some agronomists that hybrids frequently revert to type.

During the last few years a considerable number of commercial samples of Preston, Haynes Bluestem, Minnesota 169, and Marquis have been examined. The Bluestem and Preston samples were

[4] Hayes, H. K., Natural Cross Pollination in Wheat. *Jour. Amer. Soc. Agron.*, Vol. 8, 1916, pp. 209-227.

PARENTS AND F_1 CROSS BETWEEN THEM

At left (1) a Minnesota pure line selection of Durum, named Mindum. At right (3) Marquis. The F_1 cross is shown in the center (2). Note that the F_1 has longer tip awns than the Marquis parent. (Fig. 15.)

obtained from Minnesota farmers. A few Marquis samples were obtained from North Dakota and Montana. In nearly every case some white seeds (unpigmented) were found, and as a rule these bred true to the general characters of the variety. One such sort in a Marquis sample bred true for hairy chaff and closely approached the Marquis in seed shape. Results of this nature could be explained as mutations. In the light of the data here given, it seems more logical to consider that they are the result of natural crosses.

Population Problems in France

Ever facing difficult problems of infant mortality and population, France since the beginning of the war, has had to contend with even more serious phases of the same questions, and this country can profit greatly by a consideration of the steps taken by France in regard to employment of pregnant women.

The question of preserving the race at its source has been a grave one. The number of births at Paris has fallen from 48,917 during the twelve months ending in August, 1914, to only 26,179 for the twelve months ending August, 1916. In the first year of the war, 2,491 women were delivered without public aid; in the second year, 1,250 women. In the year ending August, 1916, over 95% of all live births were assisted by public benefit. The number of live births in entire France has declined from 1,011,362 in 1876 to 745,539 in 1913, largely due to voluntary childlessness.

Hence the employment of pregnant women becomes a question which has received much consideration. Dr. Adolphe Pinard, of the University of Paris, has headed those who condemned *in toto* such employment. Dr. Paul Strauss, president of the Central Office of Maternal and Infantile Assistance, has taken a different view, and together with many others, has contended in favor of employment, so regulated as to provide adequate protection for women workers during pregnancy and lactation as well as for infants and children.

This sharp divergence of view caused the appointment of a committee consisting of Pinard, Strauss and eight other specialists in obstetrics and pediatrics. Their report was made to the Academy of Medicine in the form of six resolutions, and after much discussion, the work of the Academy and its committee was crystallized as follows:

1. Pregnant women and nursing mothers employed in factories, and especially in munitions factories, should be subjected only to tasks whose nature and duration require but moderate effort. Every occupation likely to involve gradual or sudden injury, undue fatigue or insufficient sleep, should be forbidden; the half-day system is preferable. Prospective and nursing mothers should be relieved from night work and every task which might be harmful to pregnancy or lactation.

2. Rest from labor should be compulsory for four weeks preceding confinement.

3. Medical advice should be provided free on maternal and infant hygiene. Labor should be modified or suspended by advice of a physician. A female supervisor is necessary to secure the best results.

4. Provisions should be made so that mothers may nurse their infants; premiums should be awarded to mothers who nurse their infants while continuing in employ.

5. Indemnities should be provided to compensate for suspension or loss of pay.

6. Rest and retiring rooms for mothers, infants, and older children should be provided.

A committee consisting of nine members is now at work and should soon bring in a report no less important than that quoted.

WILL NOT MORALITY NECESSARILY IMPROVE?

The Correlation Between Morality and Net Fertility Found in Royal Families May Be True in All Classes of Society—Decline in the Birth Rate Brings in New and Favorable Factors

Frederick Adams Woods

Lecturer on Biology, Massachusetts Institute of Technology

THE writer of the article in the October number of the Journal of Heredity, "Will Morality Disappear?" Mr. Paul Popenoe, quotes my conclusion drawn from "Heredity in Royalty," which is that, on the average, those who were superior morally had the largest families of children reaching 21 years or more, while the morally inferior were less fertile. He also states, "While this single investigation is not adequate proof of the correlation between morality and net fertility, yet the result is no more than one would expect. There are many reasons, both medical and economic, why the children of the more vicious and depraved *naturally* die in greater numbers; and if they do, then the evolution of a higher moral state has been brought about partly by selective breeding."

The writer continues, "Royal families furnished particularly good material to test the problem, because there has probably been no artificial restraint of the birth rate there; reasons of policy make monarchs desire to have as large families as possible."

I agree that royal families furnished particularly good material to test the problem, but not "because there has probably been no artificial restraint of the birth rate there." The material is good because here enough is known about the individuals to compare the numbers of the offspring of own brothers and own sisters. Even if the total became restricted in modern times, it would merely lead to a smaller total for all living royalty; it would not *per se* affect the quality.

It is the inability to compare and contrast the numbers of brothers' offspring with brothers' offspring and sisters' with sisters' that makes most of the seemingly pessimistic evidence much less significant to the problem of the evolution of morality than is commonly supposed.

For instance, Popenoe quotes Galton, who made a study of famous divines and found them to be a "moderately prolific race, rather under than above the average." But are they not, I ask, as prolific as the average of their own social class, or, better still, are they not more prolific than the worst of their own close blood relations?

It is probable that within each social group internal forces of selection and survival are working towards improvement of the quality of the group. The total quantity of the best groups may be diminishing. There can be no question but that the birth rate among America's biologically best has of late rapidly declined. If it should keep on declining, the end of course is obvious. But many unsuspected correctors arise in nature when new factors are introduced into the struggle for existence.

NEW FORCES AT WORK

Hitherto, until within a very few years, voluntary restriction of parenthood was comparatively seldom practiced. Now that it is practiced to a far greater extent than formerly, a

new differentiation must begin, based on the parental instinct. That is, to put it in a simple way, those who are more desirous of children will have more children, and the parental instinct itself will become an element of selective value. It is the fashion for reformers to blame the selfish for not having children. That may be good preaching, but it does not get around the fact that, as far as heredity is concerned, we have now a new force working towards improved racial morality and towards the elimination of selfishness.

Here there is undoubtedly at least one vigorous corrector which must from now on begin to take effect. How far it will go we cannot say. It is a force which, within my observation, has not been sufficiently recognized in discussions on the declining birth rate. It is a force springing from one of the most fundamental of instincts, and should soon make itself felt in increasing measure.

The parental instinct is doubtless bound up with many excellent moral traits, such as domesticity, stability and sympathy. There is reason, then, to foresee a better morality in the future, based *willy nilly* on natural selection.

Another matter should be kept in mind and that is the fact that the whole nation is not, from a genealogical or natural-history point of view, in any true sense, a melting pot. Classes, subraces, breeds, and even professions tend to herd with themselves. Most marriages occur within the same social class. For this reason we must study intensively each group separately, tracing its rise and decline in quality and quantity. We must not think that we can get an idea of the merit of the United States by adding up all the qualities of its citizens and dividing by one hundred and ten million; nor should we despair if a 5% upper crust of educated classes shrank to a 3% through a greater swelling of the unleavened masses. If the upper classes can hold their actual numbers and improve by internal forces, this will be a great deal to be thankful for. The above is written merely to point out that the future is not necessarily so dark as some people suppose; it is not a suggestion that active eugenic propaganda is not needed or that governmental and legislative control may not greatly aid in the improvement of the American people.

Wanted, Photographs of Twins

The American Genetic Association desires to communicate with twins living in any part of the world. It has been discovered that twins are in a peculiar position to help in the elucidation of certain problems of heredity. Good photographs at all ages are especially desired in order to determine the degree of resemblance and its persistence through life. Any information, giving the addresses of twins, who are willing to cooperate with the Association will be keenly appreciated.

It is known that there are two sorts of twins. (1) The true or "IDENTICAL" twins are developed from a single original egg cell which at some very early stage divided to form two individual beings. These "identical" or "duplicate" twins have a nearly (though never an absolutely) identical germ plasm, are always of the same sex and resemble each other to an extraordinary degree. (2) The other kind, "FRATERNAL" twins are no more alike than brothers and sisters born at different times. They are developed from two separate egg cells.

It is fortunate for our knowledge of heredity that there are these two kinds of twins, on account of the chance it gives to study the relative importance of the influence of heredity and of environment.

It is for the study of this fundamental question of the degree of influence exerted by environment as compared with that due to heredity that the cooperation of the twins of the world is solicited and any publicity given to this notice by the press will be of great assistance.

All communications should be directed to the American Genetic Association, Washington, D. C.

FECUNDITY IN RHODE ISLAND RED BREED OF DOMESTIC FOWL[1]

Important Question of Why Some Hens Lay Many More Eggs Than Others—A Trait that Is Doubtless Inherited, but Is Transmitted Differently in Different Breeds

DR. H. D. GOODALE has been putting to a test Dr. Raymond Pearl's well-known theory for excessive egg production in fowl. Pearl worked with Barred Plymouth Rocks, where he found high fecundity to be essentially dependent on a sex-linked factor contributed by the male.

Of Pearl's theory, Babcock and Clausen[1] make the following highly complimentary comment: "It is a genuine pleasure in a mass of contradictory and illy digested data to meet with something which gives hope for the same definiteness with regard to the problem of the inheritance of fecundity that has been attained in the analysis of the inheritance of other more clearly defined characters. We cannot, therefore, but commend the patient investigation and brilliant analysis to which Pearl has subjected the problem of the inheritance of fecundity in the domestic fowl. Many criticisms have been launched against his conclusion, it is true, but it is highly probable that these criticisms involve a fundamental misconception of the nature and results of scientific knowledge."

Dr. Goodale, writing in the *American Naturalist* for June-July, 1918, does not criticise the general value of Pearl's theory, but finds the conditions somewhat different for fecundity among Rhode Island Reds. Part of Dr. Goodale's conclusions are the following:

SELECTION

Pearl's success in securing increased egg production by breeding might be due to his methods of selecting the breeders, regardless of all theoretical considerations. Families that contained all high producers were selected generation after generation to propagate the high fecundity lines. Families in which true mediocre producers appeared, *i. e.*, where segregation took place, were not used in breeding for *increased* egg production. This type of selection could hardly fail to yield results, provided that egg production is inherited. Nevertheless, it is clear that fecundity is inherited in Mendelian fashion in Pearl's Barred Plymouth Rocks. However, the results obtained by Dryden at the Oregon Station show that individual selection in pedigreed lines as opposed to mass selection may result in improved egg production quite as well as by the application of Pearl's theory.

Egg production in the domestic fowl may seem at first sight to be a highly desirable character on which to study the influence of selection. It may be regarded as a unit character if one so desires, and if, by selection, this character is changed, it is clear that selection has been effective. But it is also clear that the effectiveness of such selection in this instance rests, in large measure, at least, upon the influence exerted by various modifying factors, such as broodiness or age at first egg, discussed in this paper. It is possible to study these factors individually both by themselves and also in their relation to egg production. Broodiness is known to behave like a Mendelian dominant, while Pearl has shown that the rate of production during the winter cycle is dependent on two genes, one sex-

[1] Babcock, E. B., and Clausen, R. E. Genetics in Relation to Agriculture. New York, 1918.

linked, the other a simple Mendelian character. We have found some evidence that the presence or absence of a winter cycle in fowls that lay at all during the winter[2] follows the Mendelian scheme. Since the influence of the various modifying factors is so clear cut, it is evident that egg production is a character wholly unsuited for studying the possibility of the modification of the germinal representatives of a character by selection. On the other hand, it is a good example of a character that varies continuously, but the continuity of whose variability can be shown to depend upon several modifying factors.

There is a point of some general interest regarding the genetic composition of any given flock. Hardy ('08)[3] showed that the proportions in which a Mendelian character occurs tends to remain constant provided no selection is practiced. Fanciers often practice a certain but indefinite amount of inbreeding. Under such circumstances there would be a tendency for the fecundity factors to remain in about the proportions in which they started. We may, therefore, expect to find ready-made flocks of high producers, true mediocre producers, or even zero producers as well as those containing the several types. Thus, the original Barred Plymouth Rocks of the Maine Station contained all three types, while the Cornish contain only true mediocre and zero producers.

In spite of the fact that we have *as yet* been unable to apply Pearl's theory of egg production bodily to our Rhode Island Reds (although it may yet be possible to use it after making some modifications), there is no question but that the ability to lay is inherited, as shown by a better egg production in some families than in others. It is clear also that some males produce offspring that on the whole make much better records than those from other males when the two groups of females with which they are mated are very similar in their winter egg production. In one instance, the difference between two sets of offspring by two males was clearly due to a difference in maturity. It seems clear, moreover, that some of the internal factors, such as broodiness and maturity, segregate independently.

APPENDIX

Natural Crossing in Wheat

(*See article on page* 326)

Variety	Bot. type	No. selected	Approx. No. of plants grown	No. natural crosses observed	Per cent natural crosses
Marquis	A. S.	8	320	2 A. H. 1 Int. A. S.	0.9
Awnless sorts	A. S.	2	80	1. A. H.	1 3
Preston	B. S.	4	160	1 Int. A. H.	0.6
Turkey x Well. F	B. S.	8	320	6 Int. A. H.	1.9
Durum	B. S.	2	80	0	0.0
Emmer	B. S.	1	40	0	0.0
Average Triticum vulgare sorts			880	11	1.3

[2] The absence of a winter cycle in this instance means continuous production throughout the winter and spring, and *not* absence of egg production as in Pearl's Barred Plymouth Rocks.

[3] Hardy, G. H., Mendelian Proportions in a Mixed Population, *Science*, Vol. 28.

The Approaching Extinction of the Mayflower Descendants

(*See article on page* 296)

TABLE ILLUSTRATING THE DECLINING BIRTH RATE AMONG THE MAYFLOWER DESCENDANTS

	Husbands and wives born bet. 1810–1830	Husbands born bet. 1830-1840, wives after 1840	Husbands and wives both born between 1840–1860	Husbands born bet. 1850–1860 and wives after 1860	Husbands and wives both born bet. 1860-1880; families probably completed	Husbands and wives both born between 1870–1880
Number of children	6.0	5.6 (4 families)	3.33 (27 families)	3.0 (8 families)	2.11 (45 families)	1.5 (20 families)
Mother's family....	9.5	....	4.52	4.28	3.54	3.82
Father's family....	8.0	....	5.15	5.62	3.94	4.0

TABLE SHOWING THE AVERAGE SIZE OF FERTILE FAMILIES IN SUCCESSIVE GENERATIONS OF THE BREWSTER FAMILY

Generations..........	I	II	III	IV	V	VI	VII	VIII	IX
Number of families...	1	4	4	23	52	121	275	(1st 200 fam.)	(1st 300 fam.)
Average number of children in family...	6	4.25	7.5	6.74	6.92	7.14	6.4	5.4	4.69

The Testing of Pure-Bred Cows in New South Wales

(*See article on page* 307)

Breed	No. under test		No. completed 273 days		Average yields			
					Butter		Milk	
	1916	1917	1916	1917	1916	1917	1916	1917
					lbs.	*lbs.*	*lbs.*	*lbs.*
Jerseys..................	27	37	94	28	306	388	5,199	6,320
Milking Shorthorns.......	26	65	11	46	439	410	8,567	8,827
Ayrshires................	12	19	20	14	365	382	6,866	8,130
Guernseys................	7	15	1	8	261	326	4,516	5,923
Total...............	72	136	126	96	......	......	......	......
Average.............	......	......	......	......	327	392	5,720	7,752

The American Genetic Association

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WHAT GENETICS IS

"An exact determination of the laws of heredity," says William Bateson, "will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen."

To gain this knowledge is the object of the science of genetics, which proceeds, in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in Man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race through the science of eugenics, which was defined by its founder, Francis Galton, as "the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally."

THE AMERICAN GENETIC ASSOCIATION

is an incorporated organization, coöperative in nature. It is devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

It owns the JOURNAL OF HEREDITY, which is published monthly and sent free to each member.

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P. O. Box No. 472, Eleventh Street Station Washington, D. C., U. S. A.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. IX, No. 8 December, 1918

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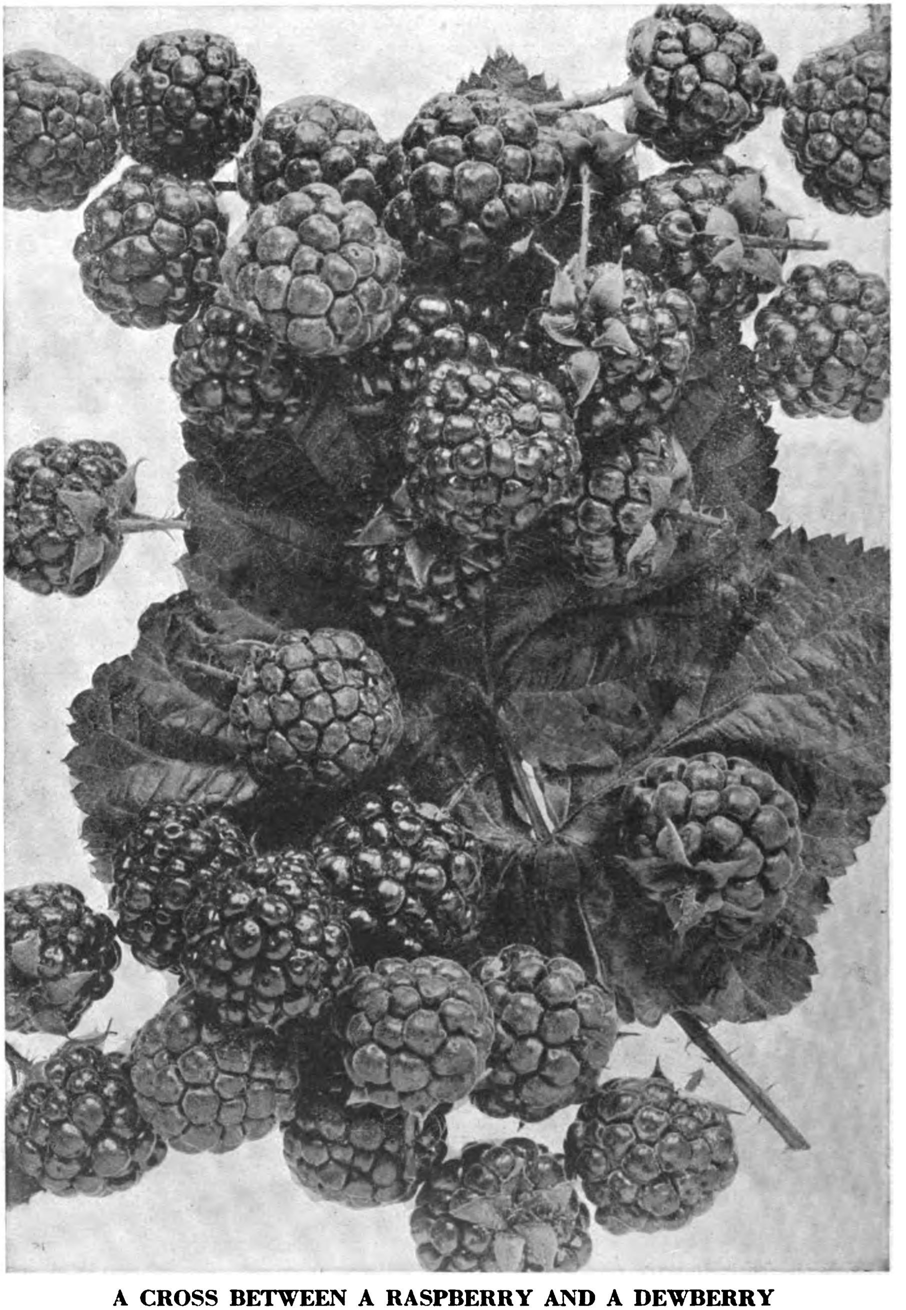
NOTE

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX will contain only 8 instead of 12 numbers.

The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Date of issue of this number, February 6, 1919.



A CROSS BETWEEN A RASPBERRY AND A DEWBERRY

The above is a life-size photographic copy of a hybrid cross between *Rubus strigosus* (the Brilliant), a red raspberry, as father, and *Rubus rubieselus*, a Dewberry, as mother. The contribution is from Mr. H. Ness, in charge of the division of horticulture, Texas Agricultural Experiment Station, College Station, Texas, who describes the fruit as "dark red to nearly black" and the flavor as mildly acid, with a strong reminder of the raspberry—very superior to the blackberry. He further says: "The drupelets adhere more to the core than in the raspberry."

This plant comes from a second sowing of seed from the first generation, of which he planted 280 plants, all more or less sterile except 5, which are so similar in all characters that no difference can be described. This year he has planted nearly 1,000 seedlings from these plants which were self-fertilized. These seedlings have, in spite of the unfavorable summer, made a growth of several feet, and appear at present to be as uniform and similar to each other as the parents. The breeding work with the Rubi is being done under the Adams Fund of the Texas Experiment Station. (Frontispiece.)

DEMOCRACY AND THE ACCEPTED FACTS OF HEREDITY

A Biological View of Government

ALLEYNE IRELAND, F.R.G.S.

IT WOULD be necessary to go back to the period of the French Revolution and of the American War of Independence to find a public discussion of political principles as voluminous as that which has poured from the printing-presses of the world during the past four years.

Of this vast literature I cannot profess to have read more than a small proportion; but what has fallen under my eye discloses the extremely interesting fact that, after more than two thousand years of controversy about political forms, opinion at the beginning of the twentieth century appears to be unanimous in accepting democracy based upon universal suffrage as the best system of government. Not the least curious phase of this unanimity is that it should have been reached at a time when democracy was engaged in a struggle in which its very existence was for a long time under the gravest threat, and from which it finally emerged triumphant only because it completely abandoned, for the duration of the war, every principle upon which democracy rests.

During the course of the discussions which are now taking place at Versailles every aspect of political practice is certain to be taken up by the delegates, and conventional political theory will, no doubt, receive the homage of oratory. The moment, then, is not inopportune to advance a certain consideration about politics which has hitherto received very scant attention —the bearing of biological laws upon political principles.

It is not without great diffidence that I embark upon this undertaking, for I am not a biologist. A simple explanation will, however, make my position clear. For twenty-five years I have been a student of government; and my studies have taken me to a score of countries, and have made me familiar with a dozen governmental systems, ranging between the extremes of the autocratic and of the democratic forms.

The broadest generalisation which my observation justifies—the one subject to the fewest exceptions—is that the best governed countries were those in which the mass of the people had the least control over the administration of public affairs. By "best governed" I mean best provided with internal peace, with justice, with honest and competent officials, with protection for life, property, with freedom of individual action, with arrangements for promoting the general welfare.

To have reached, after very long and very careful investigation, a conclusion so violently opposed to popular opinion and to the teaching of the schools, was sufficiently disturbing to lead me to a reconsideration of the whole subject for the purpose of discovering, if possible, why almost everything I had observed about democratic governments discredited almost everything I had read in their praise. To this task I devoted a great part of my time during 1916 and 1917. I proceed to summarize the results, leaving for a future article, should the matter prove to be of sufficient public interest, a fuller discussion of certain phases which are here but lightly touched upon.

On the level plain of routine, where most of us pass our lives, intelligent men are agreed that in material affairs human progress is best served by expert knowledge and firm leadership, held by the few and by them employed to direct the energy of the mass. The recognition of this fact is, indeed, the regulating principle of commerce, of industry, and of agriculture. In the field of conduct the same principle is accepted—the rare man of high morality as the guide and inspiration for the common run of men. The priest does not poll his flock as to the sinfulness of murder, nor the captain his crew as to the vessel's course, nor the architect his workmen as to the span of the arch, nor the farmer his hands as to the rotation of the crops.

Yet the moment we enter the field of politics we are asked to reverse the whole process of reasoning which has been our guide in the familiar round of duty, and to apply to the most complicated, the most technical, the most pressing problem ever presented to man's genius—the problem of modern government—a method no one has ever applied to his simple, personal affairs; the control of the expert by the inexpert.

Take a simple case. If I, a student of government, attempt to advise two axmen as to the felling of a tree, the humor of the situation strikes them at once. But if they, the axmen, differ with me as to the comparative merits of a tax levy and a bond issue, of an appointive and an elective judiciary, of specific and ad valorem customs duties, no one's sense of humor intervenes to prevent the axmen making their view prevail at the next election.

The assumption in the former case is that their judgment is better than mine, in the latter that mine is better than theirs. But, whereas, in the former case their rightness and not their number is properly accepted as the determining cause of action, in the latter the issue is held to be properly decided by *their* number and not by *my* rightness.

The explanation of this phenomenon is, in fact, simple. The principles upon which we act in our non-political capacities have been gradually evolved through a process of trial and error, and they represent a qualitative foundation for authority. The determining principles of modern political action were on the contrary, evolved in the heat of revolutions, and represent a quantitative foundation for authority. They were given their currency by rhetoric and not by reason; and they were surrounded, through the violence attending their birth, with a sanctity which has imparted to all criticism of their eternal truth the odium of sacrilege.

From these causes, and from our blind acceptance of a religious doctrine—the natural rights of man—as a practical political principle, we have fallen into a rhapsodical posture toward the democratic form of government. That this posture reflects the influence of an ultra-rational sanction is suggested by the circumstance that when, after a century or two of democratic control, democracy finds its public affairs besmirched by corruption and bedevilled by incompetence, the cry ascends to heaven "Give us *more* democracy, and all will be well!"

This is precisely the reaction of the drug-fiend. The worse his symptoms become, the louder does he call for a larger allowance of his drug. We have, in a word, brought ourselves to regard democracy as a magic elixir which, if we take enough of it, will transmute the base metal of human frailty into a glittering amalgam of virtue, wisdom, and gentleness.

So general opinion has taken up a position behind two points of defense, one that mental and moral habits acquired during the lifetime of the parents can be transmitted to offspring, the other that the law of heredity applies only to physical traits. That these theories are mutually destructive has not in any way affected their popularity amongst those who do not know that each of them is false.

Those who assume the task of reconciling the facts of democratic control with its theory adopt an expedient which places the whole issue beyond the reach of reason. They lay down the rule that democracy must not be judged by its yesterday or by its today, but by its tomorrow; and that so fast as tomorrows become yesterdays even so fast must all adverse evidence be discarded as worthless. Just below the ever-receding horizon of time there lies, almost in sight of those who accept this rule, the pleasant land where education and dietetics shall have made the majority of mankind into political units from which there can be built up a government of benevolence, righteousness, and efficiency.

THE BIOLOGICAL FACTOR IN POLITICS

My strong dissent from this view of politics rests mainly upon four broad grounds:

1. That acquired characteristics are not inheritable.
2. That within the field of man's mental and moral traits there operate immutable laws analogous to those, which are almost universally accepted by biologists, for physical inheritance.
3. That assortative mating operates unremittingly to depress one end of the moral and intellectual scale and to elevate the other.
4. That the individual and not the mass is the main source of human advancement.

Now these statements are either true or false. Of the first three biologists alone are competent to express an authoritative judgment. In my mouth they are no more than opinions. Subject, however, to what biologists may determine to be their value, it is clear that, if they are true, the whole argument for democratic government falls to the ground, or, more precisely, the argument that efficiency in government arises from, or can be made to depend upon its democratic quality.

The non-inheritance of acquired traits deals a fatal blow to the common belief that education can give the offspring of educated parents a better natural endowment than the offspring of uneducated parents. Our misconception of the function which education performs has, indeed, become embedded in the English language, for we employ the word "education" in the sense of training or instruction, whereas its fundamental meaning is "bringing out." This distinction goes to the very root of the matter. Education *can* bring out that which is in a man; it *cannot* put into a man that which is not there. It can impart facts to ignorance (ad-ducate, if there were such a word); but it cannot make a dullard bright or a fool sagacious. It is, of course, highly desirable that each generation should be, as it were, dipped by the schools into the ocean of fact, even though, for most of us, the point of saturation is very quickly reached.

Government, however, does not derive its efficiency from a mere knowledge of facts, but from their intelligent interpretation; and the reason why education cannot have a cumulative effect upon government is that intelligence cannot be taught and that knowledge cannot be inherited.

Few persons, I imagine, will refuse their assent to the statement that any political system, however perfect its mechanism, must be rendered wholly ineffective if its administration is entrusted to men of low intelligence. But it is a matter of common observation that intelligence is a quality native to some minds and foreign to others; that is to say, it is born in the brain and cannot be imparted to it from without. Those who have it possess something which cannot be bestowed or withheld by the authority of a monarch or by the vote of an assembly. Perhaps the most acute observation which has been made about the Germans is that they know everything and understand nothing.

What is true of intelligence is true also of the other mental qualities; and it is of the utmost importance to the

present enquiry that we should know whether these qualities, which cannot be produced by education, are transmitted by inheritance. So far as this question relates to genius it has been the subject of a number of researches, of which Francis Galton's "Hereditary Genius" is a familiar example. But so far as it relates to all the mental qualities—good and bad, strong and weak—I know of but one careful and extensive investigation, that contained in Dr. Frederick Adams Woods's "Mental and Moral Heredity in Royalty."

From an elaborate study of the royal families of Europe during four centuries, Dr. Woods reaches the conclusion that mental and moral differences are almost entirely due to the influence of heredity, and that they are but slightly affected by environment. Dr. Woods's investigation is, so far as I am aware, the first in which the influences of heredity and of environment in man have been separated and measured. Of great interest from the political and social standpoint is the correlation between mental and moral qualities, which Dr. Woods's figures revealed. Averages show that persons strong in mental qualities are usually strong in moral qualities as well.

IMPORTANCE OF LEADERSHIP

To these facts about the hereditary quality of mental and moral traits another must be added if a full appreciation of their force is to be reached. Throughout all human society there is a strong tendency for like to mate with like—the rich with the rich, the successful with the successful, the poor with the poor, the intelligent with the intelligent. This tendency exerts a powerful cumulative influence, which is constantly widening the gulf which separates mediocrity from talent; and the lapse of time is, therefore, making, talented families more talented, and forcing others further and further below the line of mediocrity. It appears, then, that mankind is not breeding towards an average, but towards two extremes.

I pass finally to what history teaches us of the importance of greatness in the individual. The question resolves itself actually into a choice between a qualitative and a quantitative theory of causation in human achievement.

To whatever phase of human development we turn, history fails to furnish a single instance in which an accomplished step in human progress can be referred, ultimately, to any cause other than the quality of greatness in the individual. It is this quality which has given the world all that has ennobled man's character, elevated his culture, and extended his mastery over the material elements of life. It is to the genius of a few hundred individuals among the thousands of millions who have lived, that we owe all the inspiration of religion, philosophy, music, art, and literature; all the benefactions of science, discovery, and invention.

We appear to be at the threshold of an era in which the last shred of authority is to be stripped from wisdom and talent, in which the destiny of the world is finally to be committed to the blind God of Numbers. If biology can enforce a teaching by which this catastrophy may be averted, the interest of humanity demands that the effort should be made before the hour of its possibilities has vanished.

Assistant Secretary Ousley Tells Need For Still More Food Production

Declaring that "this situation and the fact that 2,000,000 men in France hardly could be demobilized in time to restore normal farm labor conditions for the next year's planting and cultivation," Clarence Ousley, Assistant Secretary of Agriculture, in an address before the New York Humanitarian Society, said that city people must help the farmers in even larger numbers in 1919 to insure adequate harvests of food crops.

ANOTHER HEN THAT CROWED

William H. Gates
Professor of Zoology, Louisiana State University, Baton Rouge, La.

THE assumption of the secondary sexual character of the opposite sex by an animal has been noted and mentioned in a number of papers. The Journal of Heredity illustrates the case of a Buff Orpington hen which acquired the characters of the male in the matter of the comb. A somewhat similar case occurred in our own flock of White Wyandottes and a more or less complete examination of the individual was made.

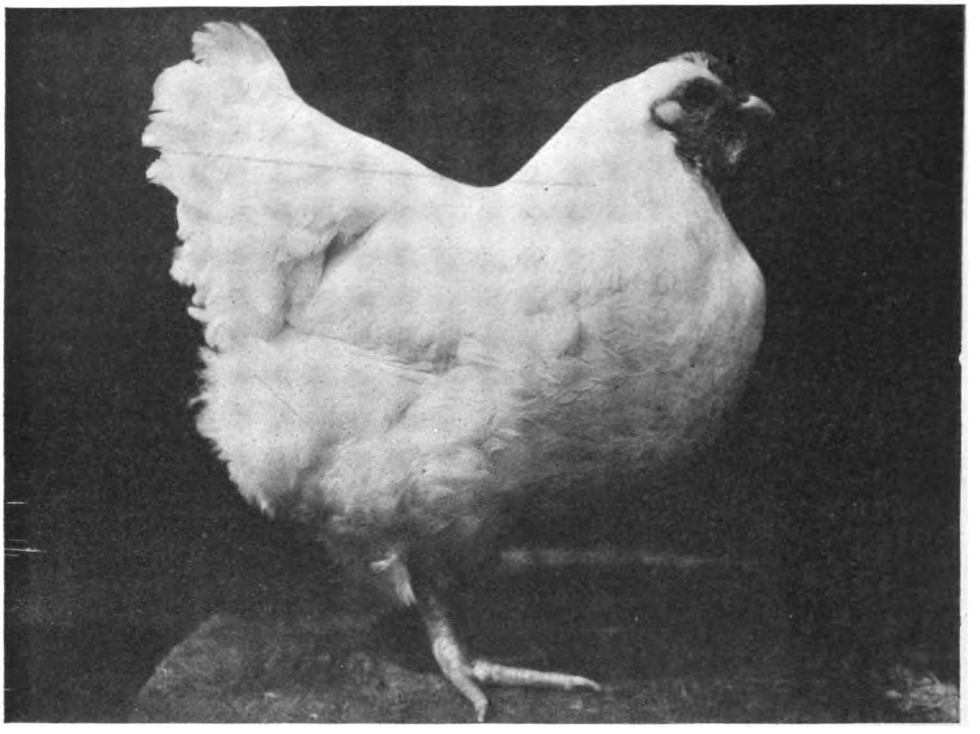
The hen was hatched on March 24, 1913. Both her sire and dam were of good "show stock" and were exhibited a number of times and won several first prizes. She herself, however, was not a show specimen, but during her pullet year turned out to be an extra good layer. She was not trap nested, but was in a pen of but five birds and could therefore be easily watched and her performances noted. It is not a difficult matter in a small pen of this size to learn to know the egg of each individual, and while one is apt to slip up at times and make a wrong guess, on the whole the records are fairly accurate. The laying record of this hen, made in this way, shows her to have laid 196 eggs during her pullet year. It was on the basis of this record that she was kept in the flock and was mated for breeding purposes in both 1914 and 1915. It was also on this record that she was kept over the molt in 1915 with the intention of using her again in 1916 breeding pens.

While there are no absolute records of the number of eggs laid by this hen in the breeding pens, there is satisfactory evidence that she did her share of the laying, for at the end of the season she showed every sign of having been a consistent layer. Such characteristics as pale shanks and beaks, late molt, etc., which, as every poultryman knows, indicate that a bird has not been idle.

There is no record of the number of times this hen went to setting during her pullet year, but in the breeding pens she went to setting twice in the season of 1914 and three times in 1915, showing again that she had probably laid the normal number of clutches of eggs.

Up to the fall of 1915 she showed no sign of being anything but a perfectly normal hen. Her comb, if anything, was smaller than the average Wyandotte, probably an inherited quality of the shown characteristics of her parents. Her shanks were clean and free from stubs and feathers, and the spur head, as in other hens of this variety, was hardly noticeable. During the molt of 1915 this hen lost all of her feminine characteristics and assumed decidedly those of the opposite sex. The comb increased to that of the average male of fancy stock; the spurs, which up to this time had been entirely dormant, grew very rapidly, reaching the size shown in the photograph in about three months; both the hackle and saddle feathers, while not as fully characteristic as in the male, showed the distinctive narrow feathering.

In her actions she changed completely; she started crowing, and in a short time developed a full, prolonged crow. She, however, crowed only early in the morning, never, so far as known, after she left the roost, but regularly every morning she would crow for an hour or so before daybreak. When given grain she would call the other hens with the characteristic clatter. When entirely separated from males she was occasionally known to tread other hens. In fact, in every particular she seemed to have acquired the male characteris-



HEN WITH MALE CHARACTERISTICS

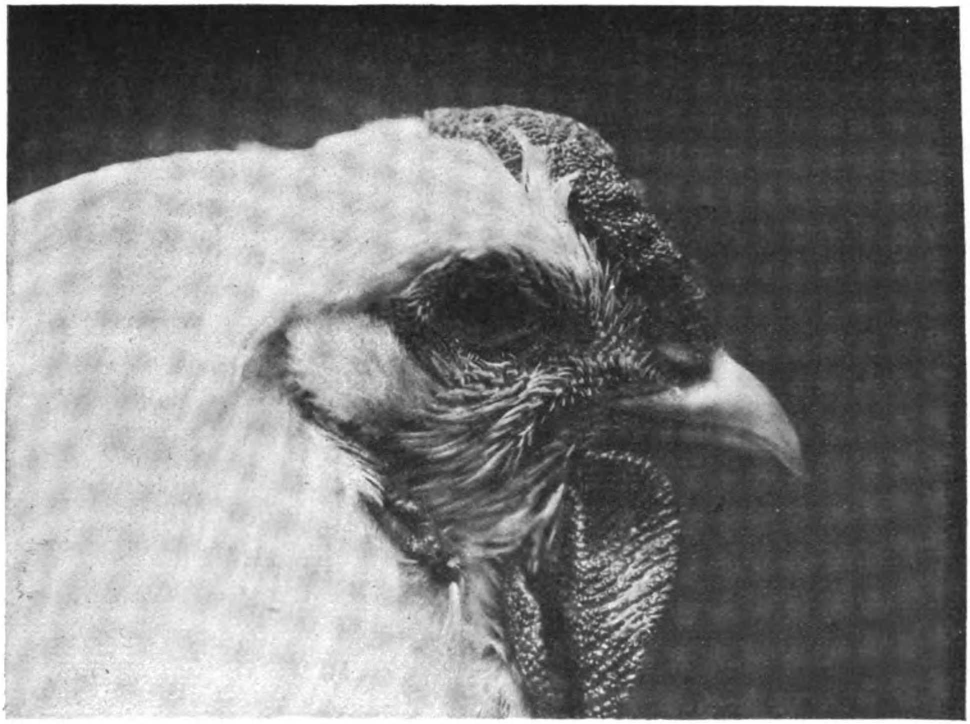
Photograph of the hen that crowed, just before being killed. Notice the partial development of the narrow hackle and saddle feathers. (Fig. 1.)

tics both in her appearance and actions. The growth of feather stubs between the toes during this last molt, while not characteristic of male, evidently indicated a change in her constitution for there had been no indication of anything like this at any time previous.

She was killed in the laboratory during November, 1915, and a careful examination of the reproductive system made. The oviduct throughout its entire length, including Fallopian tubes and uterus, had atrophied, consisting of a wrinkled mass of fibrous connective tissue. The lower glandular portion of the oviduct had shrunk to the size of an ordinary match and was tough and hard.

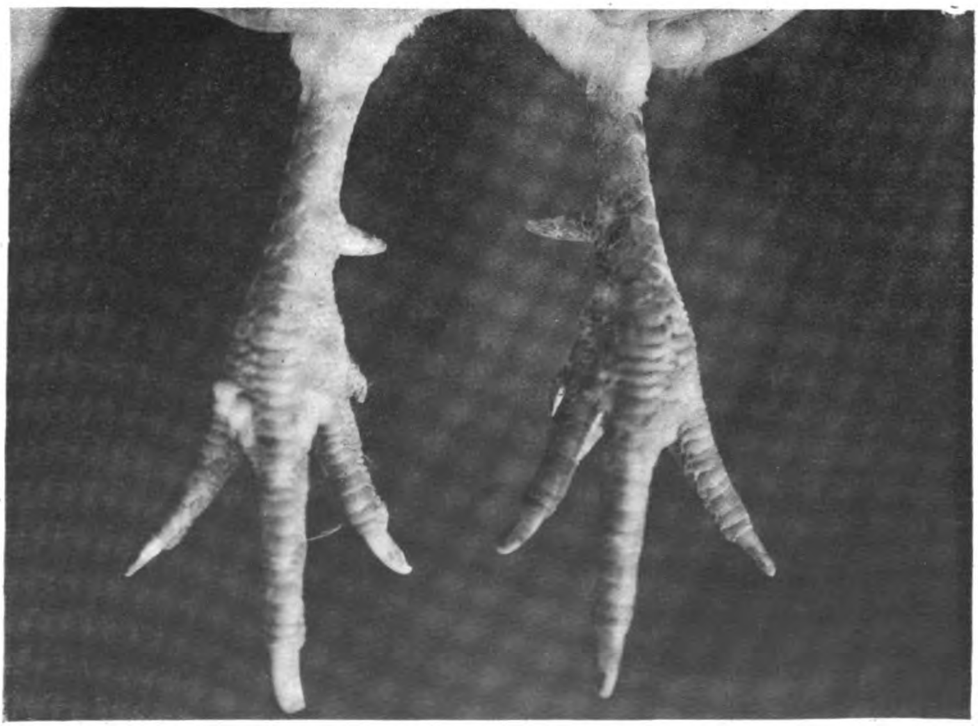
Fig. 4 is that of a normal ovary in a completely dormant state, that is after the hen had been setting on eggs for three weeks. This same ovary in cross section showed the follicles and the ova in all stages of development, normal connective tissue being present in the spaces between the follicles. Externally there are no indications of any follicles, but there were scars of ruptured Graafian follicles. In the ovary of the hen that crowed there were no follicles; the entire ovary showed complete cystic degeneration. It was a mass of connective tissue cells surrounding the large cystic cells. Scars of apparently normal Graafian follicles were present. The large cystic cells were all more or less filled with secretion granules.

Summary. — A perfectly normal White Wyandotte hen, after having two years of normal life in which her reproductive functions showed above the average, lost this capacity and in a short time acquired all of the characteristics of the male both in appearance and actions. Upon dissection the cause of these changes was found to be the cystic degeneration of the ovary, the entire organ having lost its normal structure and instead filled with a mass of connective tissue and cystic cells.



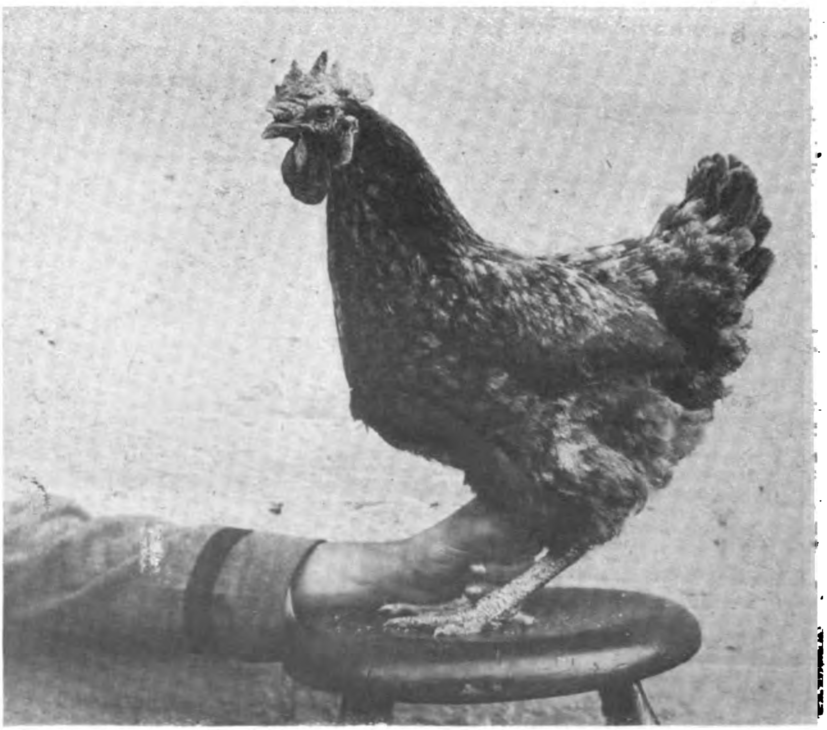
HEAD OF A HEN THAT CROWED

A view of the head, a little smaller than natural size. Note the enlarged comb and wattles and particularly the development of the feathers of the neck, giving that full, arched neck, characteristic of the male. (Fig. 2.)



A view of the feet, smaller than natural size, showing the development of the spurs, which are slightly more slender than the average male. (Fig. 3.)

A normal hen ovary in a dormant state. Photograph taken after hen had set on eggs for three weeks. Eggs in various stages of development are shown. (Fig. 4.)



Still another hen that crowed. A Rhode Island Red that acquired the male characteristics in the comb, and in crowing. The comb in this case was enormously developed, considerably above that of the average of this variety. This hen crowed almost constantly. She was said to be normal in her younger days, and assumed the male characters during her fourth year. (Fig. 5.)

The head of the hen in Fig. 5. Note the size and coarseness of the comb, which is unlike the males of this variety. The complete history of this hen could not be obtained. (Fig. 6.)

Inheritance of Absence of the Sense of Smell

Some time ago one of our correspondents inquired whether the absence of a sense of smell was hereditary. At that time we had never heard of an instance and the literature, so far as known to us, made mention of no cases whatever. Quite recently, and entirely by chance, an example of this rare defect has come to our notice.

The person in question is quite devoid of the sense of smell. Odors, perceived by ordinary persons in the ordinary way, if sufficiently strong, are simply "felt." The person in question, a man, has a brother affected in the same way. Their mother likewise had the same curious defect. In the same family there is a first cousin also without the sense of smell, but this case is really an independent heritage brought in from another family. Apparently the locus of origin, in Russia, is a locality in which this defect is being inbred.

So far the number of instances and certain other details are too meager to allow us to say anything very specific about the manner of inheritance, whether, for example, the trait is sex-linked or not. Still it does seem safe to classify it among traits that reappear in succeeding generations and therefore is hereditary. — O. C. Glaser, *Good Health*, December, 1918.[1]

[1] Professor Glaser has also discussed this case in *Science*, December 27, 1918.

KAISERISM AND HEREDITY

Despots Are Largely the Product of the Breeds of Kings—Ancestry and Relationship of Caligula, the Roman Emperor—Comparison with the Kaiser

Frederick Adams Woods

Lecturer on Biology, Massachusetts Institute of Theology

A GREAT sensation swept over the German Empire in 1894. The young Kaiser, fresh in his untried power, had been, in a thinly veiled innuendo, compared to that horrible tyrant of the Roman Empire, Caligula Caius Caesar. It was all the result of a small *brochure* written by a quiet scholarly professor, of socialistic proclivities, one Quidde by name. The sensation lasted for some time, and was intensified by the appearance during the same year of a second publication, an anonymous supplement by the same author, *"Ist Caligula mit unserer Zeit vergleichbar?"*

The first pamphlet passed through twenty-nine editions before September, 1894, at which time, it is now amusing to see, the British *Saturday Review* referred to it as "a scandalous and outrageous production." Professor Quidde was a mild and well-meaning idealist whose vision anticipated the coming Caesarism in Germany, with all the evils attendant upon irresponsible control in the hands of one man. Of course there was much that was unjust in a complete comparison of the Kaiser with Caligula, especially in carnal characteristics—dissipation, gluttony and indolence. But there were many points of similarity—enough in fact to bring Quidde unpleasantly near a prison sentence. The German government had a delicate problem to handle. They did not care to fan the flames; yet how could they pass unnoticed such an outrageous example of *lèse-majesté?* It is said that at the trial the government prosecuter asked Quidde whom he had in mind when he wrote that article about Caligula. Quidde very cleverly replied, "I had in mind Caligula, but whom did *you* have in mind when you asked me the question?" The whole affair was too intangible. The matter was dropped and passed out of men's minds.

Now that subsequent events and the great war have brought out the truth of much of Quidde's grim foreboding, it is interesting to reconsider the life and characteristics of this arch tyrant of Rome, particularly in relation to the inheritance of mental and moral qualities as revealed by a study of the house of Caesar, that extraordinary family to which Caligula belonged. Caius Caesar, to give Caligula his true name, making all allowances, was undoubtedly one of the worst examples of royal tyranny, unchecked brutality, and egotistical madness that the world has ever seen. It is true that a large portion of Tacitus dealing with this period is lost, that Suetonius was a gossiper, and that aside from the dry narrative of Dio, we have comparatively little in the way of contemporary sources; but enough remains to make it fairly certain that the accounts about Caligula are substantially correct.

Baring-Gould has written a painstaing and apparently impartial work dealing with all the members of the family of the Caesars, from Julius Caesar to Nero. He does not in the least show a disposition to belie his characters, nor does he fail to bestow praise where praise is due. He discusses the sources of our knowledge of these persons in the light of modern criticism, yet his conviction is very certain that as far as Nero and Caligula are concerned, there is every reason to

believe the worst that has been said about them. The same idea is gained from reading H. F. Pelham's "Early Roman Empire" in the *Quarterly Review* for April, 1905.[1]

Caligula, who, on his accession, was but twenty-five years old, began his reign very promisingly and ruled in a sensible manner for about eight months, when a sudden sickness overcame him, and ever afterwards his nature was changed. It is highly probable that this disease was a severe form of epilepsy, a malady from which the great Julius Caesar is know to have suffered. Such is the opinion of Baring-Gould, whose characterization of Caligula is presented in the following excerpts, taken from that writer's comprehensive work, "The Tragedy of the Caesars." It may be said in passing that the picture drawn by Professor Quidde was no more sensational than the one contained in this seemingly impartial work by Baring-Gould.

"Now, Caius Caligula we know suffered from both the worst form of this disorder [epilepsy] as well as from the less serious; and there can be little question that the sickness mentioned by the historions, but unfortunately not described by them, was a violent attack of epileptic fits, which when they passed left Caius in a measure deranged. Surely this table speaks for itself." [Baring-Gould has here inserted a small chart showing insanity in six members of the family. The relationships of these six and others of the family are shown on the chart, page 350, of this journal.]

"Whatever his malady was, the prince rose from it very much changed, if not in disposition at all events in conduct. If hitherto he had worn a mask, with convalescence he cast it aside; if for a period of a few months he had rejoiced in the favor of the people, and had striven to retain it, he now found a pleasure in striking awe into their hearts, and in dissipating every particle of the affection he had inspired.

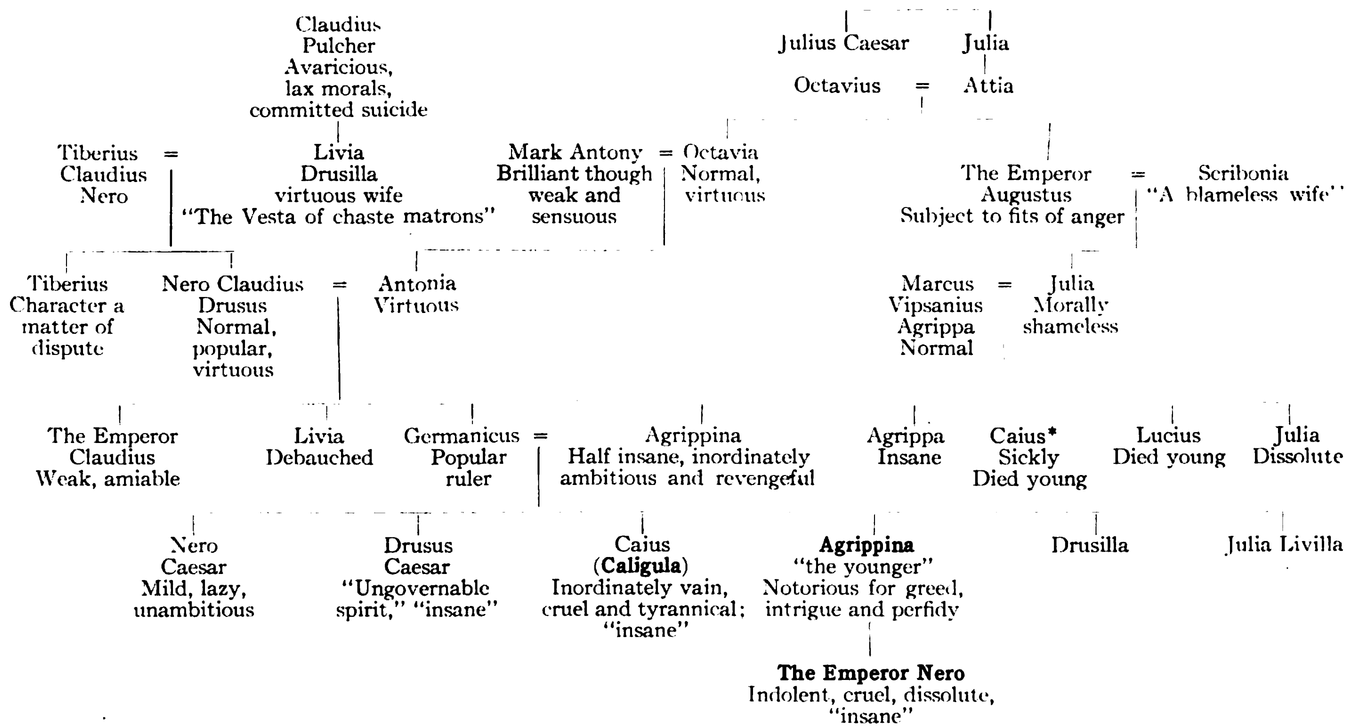
"He began to suffer from want of sleep; he seldom obtained more than three or four hours rest in the night and then could not sleep soundly, as he was disturbed with frightful dreams, fancying that old Ocean conversed with him in roaring tones. Unable to be quiet when sleep forsook him, he would sit up in bed the prey to wild fancies, schemes and terrors, or ramble about the porticos of the palace, looking out for the approach of day.

THE TYRANT

"Almost from the moment that he arose from his sick-bed, Caius behaved in a manner the reverse of his previous conduct. Some of his actions were certainly those of a madman, but he had intervals of sense, though he never again returned to the amiable mood of the first stage of his imperial career. To describe in a few words the change that took place in him, Suetonius says that at first he acted as a prince, afterwards as a monster.

"At the time of his sickness he had drawn up his will in which he constituted his second sister, Drusilla, to whom he was devotedly attached, heiress of his property and of the empire. He snatched her away from her husband and associated her with himself in a manner that gave rise to scandal. She had been united to Cassius Longinus by Tiberius, but Caius apparently after his sickness, divorced her from Longinus and married her to a creature of his own, M. Lepidus, and then took her from Lepidus and startled even dissolute Rome by the declaration that he proposed marrying her. This relation —even in Rome, not squeamish as to moral scandals—was regarded as one crying out to heaven for vengeance. . . . On medals and on cameos, the heads of Caius and Drusilla appeared together; and it is possible that he would have carried his daring purpose

[1] A review of the works of nine different writers on Roman history.



PEDIGREE OF THE CAESARS

Nero, Caligula, and Agrippina "the younger" were the most notorious of all the Caesars for their cruelty, tyranny and perfidy. They are here shown at the bottom of the chart, very closely related.

* Trouble probably caused by a wound.

into effect, and have openly married her. But his mad career was frustrated. The unhappy girl fell ill, with shame may be, and died. Caius was plunged in a frenzy of despair.

"Unable to find rest in his Alban villa, the mad prince roved through the cities of Italy and Sicily, and let his hair grow in token of sorrow. He would thenceforth swear by no other oath than the divinity of Drusilla. . . . But now intoxicated with power and elevation, he became convinced of his own deification. . . . Philo tells us the line of reason Caligula pursued: 'If the shepherds are of a different order from the sheep they pasture, and the bullock-drivers from the cattle under their rods, then I must be distinct and superior in kind from the mortals I rule.'

"He assumed a beard of finely beaten gold thread, and passed along the streets, thus adorned, to be saluted as Jupiter; then he would appear with wings at his heels and adjusted to his cap, to represent Mercury; then with a bow and quiver, his head surrounded by flashing rays, as Apollo. It was even said that he attempted to pass himself off, in appropriate costume, as one or other of the goddesses. . . . He went about surrounded by a train of attendants, who were dressed as the ministers of the deity he was pleased to personate at the time, and his gold statue was supplied with suits of clothes which were changed daily to correspond with those worn by Caligula. He ordered the most famous statues to be brought from Greece, and then removed their heads and substituted his own for theirs. . . . "Drunk with flattery, and with sudden succession to absolute power . . . 'abandoned himself to wine and gluttony.' "

"The inordinate vanity of Caius made him resent anyone being thought to be better than himself in any way. In his insensate jealously, he forbade the Pompeii to bear the name of Magnus and the Torquati to wear their golden torques, and the Cincinnati to flourish a curl on their temples, as hereditary badges of their illustrious families. When Ptolemy, son of King Juba, and his own cousin, whom he had invited to Rome, entered the theater in his purple robe of royalty, all the spectators rose to stare at him. This so stirred the bile of Caligula that he had him put to death. There was in Rome a very tall man who went by the name of Colossus. Caligula, observing him in the amphitheater, ordered him to be dragged from his seat and thrust into the arena, and forced to contend with a gladiator, and when he proved more than a match for this man, then with a second. On his worsting this opponent also, he commanded the tall fellow to be bound, clothed in rags, and drawn up and down the streets, and after being exhibited in this sorry plight to the women, to be then butchered. There was, says Suetonius, no man, of however mean a condition, whom he did not envy, if that man were suspected of any excellence that might excite his envy."

Such then, is the picture of Caligula. The above is but a fraction of all that is brought together—testimony in its completeness and in its corroboration undeniable and unassailed. The same may be said of Nero. Testimony remains of such a nature that historians are forced to retain the view that Nero was of a type of bestiality and cruelty rarely exhibited among the world's sovereigns.

Here, then, is our first argument in favor of the hereditary origin of the characteristics of Caligula. Many thousands of absolute rulers have existed in history. Only a very few of these have been as debased as either Caligula or Nero, yet Caligula and Nero, two extreme examples, were as closely related as uncle and nephew. We only realize how close this relationship is when we remember that all the ancestors of any man's uncle are also ancestors of his own. In addition to this is the fact that of all women in history, few, if any, can show a blacker record than Agrippina "the Younger,"

a sister of Caligula and mother of Nero. Also the mother of Caligula, Agrippina "the Elder," was, according to Baring-Gould, "probably half insane." If we are to trust the rather condemnatory Jacoby, she was "subject to uncontrollable fits of anger." Other members of the family considered by Baring-Gould to have been insane are Drusus, the brother of Caligula, Agrippa his aunt, and Julia, his grandmother, who is characterized as exhibiting "moral paralysis." All accounts agree as to the shamelessness of Julia's life. Indeed she is one of the most notorious women mentioned in Roman history. The insanity that ran in the family, the epilepsy (inherited perhaps in the combined strains from Julius Caesar), the concentration of the family degeneracy, in the pedigree, in the persons of the above three—Caligula, Agrippina "the Younger," and Nero—combine to make a very strong case for causation through defective germ-plasm. But it is not by any means the concatenation of insanity and moral depravity shown in the pedigree of Caligula that compels us to conclude that his exaggerated traits were the product of inborn defects ultimately traceable to the chromosomes of germ-cells. All our modern discoveries in heredity point toward the far-reaching principle of segregation of unit characters, more or less definite, and sufficiently clear-cut in outline, or in the nature of their substance, to be spoken of as traits. Here good characters alternate with bad. If environment were the chief cause of the depravities of some of the members of the Claudian and Julian branches of the house of Caesars (shown on the chart) we should not expect to find their close relatives failing entirely to exhibit any such defects.

VIRTUOUS MEMBERS OF THE FAMILY

Nero Caesar, uncle of Nero and brother of Caligula, is characterized as mild, easy-going and unambiticus. He is a contrast to his notorious kinsmen, and in character he resembles his father, Germanicus, his uncle Claudius and his grandfather Nero Claudius Drusus. The chart shows that a number of the women in both branches of the family were, as far as can be known, both normal and virtuous.

The old idea that degeneration in families is due to the environment in which they have lived has got to be given up. The modern view that acquired traits are not transmitted is enough in itself to negative such a notion. But the principles of the transmission of hereditary traits, as we understand them today, explains much that has happened in human history—pure transmissions, combinations, segregations, all obedient to the law of averages. It would seem that nearly all the misery brought into the world by Caligula and Nero came about because a defective royal strain was allowed to perpetuate its kind. If royalty and its culmination, Caesarism, are to be feared, how very important it must be to guard against the formation of such breeds. before their existence has made their control impossible. Tyrants work insidiously. The growth of their power is gradual and their own subjects seldom notice the conditions imposed. Exploitation of the masses is easy, for man is naturally an exploitable animal. The fashion of obedience becomes established, so that, more and more, all individualism is discouraged, and command from a superior in rank is the touch-spring of action.

The latest Caesar has seemingly been eliminated, but Caesarism will rise again as long as the laws of heredity continue to act. Power will seek to mate with power and the majority of mankind will remain as an exploitable mass. No laws of man can change the laws of nature. The best that man can do is so to direct these laws of nature that the dangerous breeds shall be kept at a minimum. The evil influences of the baser elements, and the need for restriction of undesirable elements among the poorer classes have been widely rec-

ognized, but the need for public control of the mating of sovereign houses has scarcely been realized. Nor is it likely to be realized at the present day. But the argument is there, nevertheless. If Caesarism must be abolished, and if despots are largely the result of hereditary forces, then the only way to eliminate despots is to regulate the sources from which they spring. It will be objected that evil tyrants may come from the middle classes—Napoleon for instance. The answer is that they do not as often come from such origin as from the breeds of kings. The argument remains just the same. As far as they *are* recast in the ancestral mold (and our increasing knowledge makes us more and more believe that important psychic differences are due to heredity) then just so far the number of despots can be reduced by a control of the marriages from which they usually originate.

Iowa Agricultural Experiment Station Annual Report, Ames, Iowa

The following is taken from the report of the activities of the Iowa Agricultural Experiment Station, submitted for the year ending June 30, 1917.

The work of the year was characterized by satisfactory progress with regard to all of the active projects of the station. Special emphasis was placed upon the following lines of investigation: Improvement of crops and live stock by breeding; improved methods of growing various farm crops and the management of soils; new and better methods of feeding and handling live stock; up-to-date methods of manufacturing and marketing dairy products; the growing and marketing of fruit and truck crops; the control of insect pests and plant diseases; modern methods for housing live stock and storing crops and up-to-date systems of farm management.

Adams Fund projects were carried on successfully during the past year on the same basis as in the preceding year. Interesting and valuable data were secured from each of the five projects listed below:

1. A study of Mendel's law in cattle breeding. (By the Animal Husbandry Section).
2. Arkansas dairy cattle improvement work. (By the Dairy Farm Section in coöperation with the Chemical Section.)
3. Apple-breeding investigations. (By the Horticultural Section.)
4. Humus investigations. (By the Soils Section.)
5. A study of humus and its relation to the physiological activities of the apple. (By the Horticultural and Soils Sections.)

During the year the Chemical Section did not coöperate as heretofore with the Horticultural Section in the apple breeding investigations. In the work connected with the humus project, particular attention has been devoted to the study of the evolution of carbon dioxide as a measure of the rate of decomposition of organic matter in the soil. Experiments were carried on which involved the treatment of soil with varying amounts of stable manure alone, and with lime. Very interesting conclusions were reached in this line of investigation.

The Arkansas cow work continues to be the most extensive investigational work carried on by the Dairy Husbandry Section. There are at this time 28 animals on hand, including the first, second and third generation grades by purebred dairy bulls.

The work on the Adams Fund projects will be continued next year practically without change.

PLANT BREEDERS FIND NEW TOBACCO HYBRID

NEW TOBACCO HYBRID KNOWN AS MONTGOMERY SEEDLEAF

Seed plants after harvesting the remainder of the tobacco. This crop yielded 2,750 pounds per acre. Montgomery Seedleaf is a cross between Washington (Ohio) Seedleaf and Big Graham. They have erect leaves in strong contrast to the parent varieties, both of which are of decidedly drooping habit. (Fig. 7.)

From a series of plant-breeding tests with tobacco varieties started by the Ohio Experiment Station in 1903, a hybrid known as Montgomery Seedleaf has proven to be superior to common strains The intercross has been developed so as to increase the size and number of leaves without bringing in serious drawbacks such as weakness of stalk and susceptibility to drouth.

This variety, which has been developed at the Southwestern Test Farm, Germantown, has also been grown in a commercial manner by tobacco men in that section. The selected strain took first premium at the Darke County Fair in competition with a class of seventeen entries. In the green stage the stalks are about three feet in length.

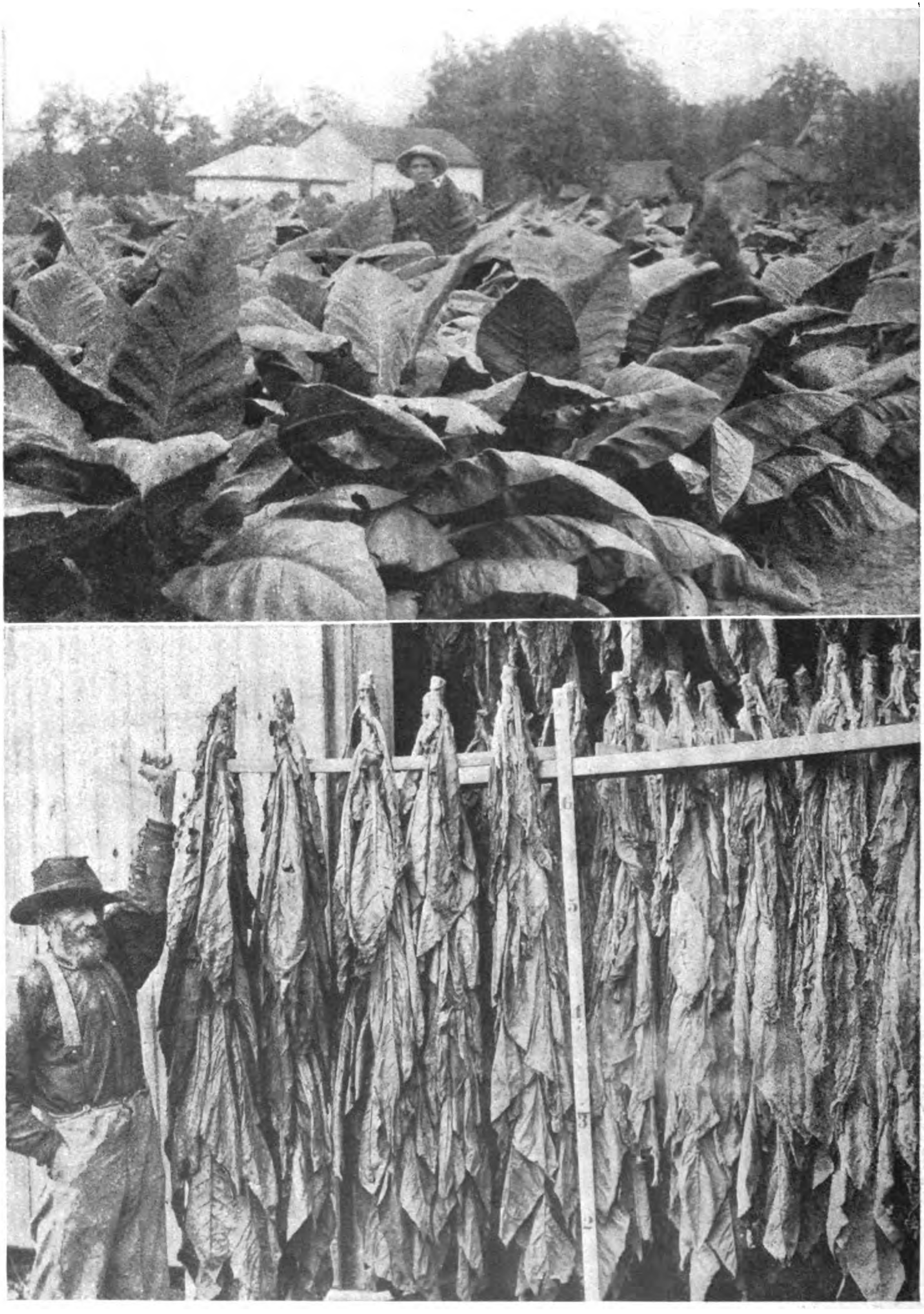
The yields of the new hybrid are superior to the common strains of tobacco, one instance being recorded of more than 2,000 pounds to the acre.

In further description of the new hybrid, Mr. True Hauser, Assistant Botanist at the Ohio Experiment Station, contributes the following to the JOURNAL OF HEREDITY:

The Montgomery Seedleaf (Hybrid No. 199) is a cross of Washington (Ohio) Seedleaf by Big Graham. The strains which are propagated have erect growing leaves, in strong contrast to the parent varieties, both of which are of decidedly drooping habit. This new variety is very drouth resistant. It does not readily bloom during severe dry weather but resumes vigorous growth after the drouth is broken. This tendancy makes it necessary, some years. to top the plants before the buds have formed. At the Test Farm we have frequently obtained yields of more than 3,000 pounds per acre and in some instances over two tons exclusive of trash.

A NEW DROUTH RESISTANT TOBACCO HYBRID

Seed plant of tobacco hybrid (Montgomery Seedleaf) on farm of Mr. True Hauser. It does not bloom readily during severe dry weather but resumes growth after the drouth is broken. (Fig. 8.)



NEW TOBACCO HYBRIDS

Upper photograph: Montgomery Seedleaf tobacco hybrid on farm of Mr. Gustavus Baughman, Ansonia, Ohio. Yielded 2,640 pounds per acre in 1913. Lower photograph: Partly cured hybrid on farm of Mr. True Hauser, Germantown, Ohio. (Fig. 9.)

VARIABILITY IN THE RADISH[1]

Excessive Variation of Root Crops Handicaps Commercial Grower—Careful Selection Should Secure Constancy—Seed of Ideal Types Should be Selected

E. EUGENE BARKER AND R. H. COHEN

New York State College of Agriculture, Cornell University, Ithaca, N. Y.

ALL the root crops used as vegetables show great variability in most of their characters, especially in size and shape. This is true even in those kinds and varieties which are supposed to be most true to type. The best seed obtainable from the most reputable firms is subject to this same fault.

This study was undertaken with the purpose of obtaining some accurate data as to the exact amount of variability in a representative kind of root vegetable. It was also desired to ascertain what genetic factors most affect the yield. Three standard commercial varieties were obtained from a seed-house of good reputation. Two of them, Scarlet Globe and White Box, were supposed to reach marketable size in four weeks from the date of planting, while the third variety, White Icicle, was a six-weeks variety. Four hundred seeds of each variety were planted 2 inches apart in rows in apparently uniform soil in the garden. They were planted about the middle of July and were harvested and the data taken after growing four and six weeks, respectively. Owing to very hot and humid weather that prevailed during this time, they were all much overgrown for market size. Their coarse, pithy quality was due to the same causes. This was especially marked in the White Icicle variety whose final two weeks of growth were excessively hot.

THREE VARIETIES DIFFER GREATLY

The three varieties differed greatly in regard to germination. (Fig. 10.) From 400 seeds of each variety, Scarlet Globe germinated 246 seeds or 61.5%, from which were obtained only 176 roots that could be considered marketable; White Box germinated 240 seeds or 60%, from which were obtained 236 roots of marketable size; and White Icicle 320 seeds or 80%, from which were obtained 276 well-formed roots of the typical White Icicle shape. The remainder, which were discarded, were not true to type, 33 of these being "rogues," apparently of a different type, and 11 failed to produce any good root at all.

An interesting condition came to light in the White Box variety, indicating that careless selection had been practiced in saving the seed. A few dozen plants were about to bloom or had already come into flower when the roots were dug. The roots of these precocious plants were all long and thin and not at all suitable for eating. About one-fourth of all seeds of this variety planted produced such roots. These were discarded which accounts for the peculiar distribution for weight in the White Box variety, which is seen to be entirely on one side of the mode.

IDEAL SHAPES CHOSEN

The measurements taken on each variety were weight in grams and length (exclusive of the tap-root) and greatest thickness in millimeters. The Scarlet Globe and White Box varieties are ideally globular in shape, while the White Icicle is ideally long cylindric. In order to have a standard constant

[1] This study was carried out by the junior author during the summer of 1917 in the Plant Breeding Garden at the New York State College of Agriculture, Cornell University. All data were taken and statistical computations reckoned by him.
Paper No. 71, Department of Plant Breeding, Cornell University, Ithaca, N. Y.

for shape, an index was reckoned by dividing the length by the width. This index should be 1 for the two-round varieties because the length and width should be equal; the index for White Icicle should be somewhere between 4 and 5, because the length of this variety exceeds its width. The mean index for Scarlet Globe was 1.35, the mode falling at 1.02 which indicates that this variety was too long for the ideal shape. Only 21 out of 176 roots were really true to type, having an index of 1.00. White Box had a mean of .97—very close to perfect, but the mode or class of greatest frequency was at .86. Thus the greatest number of uniform shape were too short or oblate. Only 20 plants out of 236, or 8.47%, were ideal. White Icicle had a mean index of 4.25, the mode falling at 4.32.

SCARLET GLOBE EXTREMELY VARIABLE

Scarlet Globe was extremely variable in its shape, as shown not only by its coefficients of variability of 25% and 23%, respectively, for length and thickness, but especially by that for index of shape, which was 90.39%, as against 21.96% for White Box and 26.55% for White Icicle. Scarlet Globe also showed indications of comprising more than one genetic strain for length, as indicated by its several modes. The larger of these modes nearly coincided with the mean or average of the population.

It will be seen from inspection of the accompanying table of constants, which will show, perhaps, better than a discussion, that there existed a great amount of variability in all three varieties in regard to weight, length, width, and general shape. (Appendix, p. 384.)

Weight was the most variable character in all three varieties, the coefficients of variability for this character in Scarlet Globe, White Box, and White Icicle being, respectively, 49.15%, 66.72%, and 55.34%. The difference between the mean or average and the mode or weight of greatest frequency shows how far from uniform these samples were. In Scarlet Globe the greatest frequency was found to be at 10.5 grams, 17% of the whole number of roots occurring in this class, although the mean or average of the population was 12.58 grams. In White Box the mean was 17.22 grams, but the greatest number of roots of uniform weight fell in the class 3.8 grams. This light-weight class comprised 18.35% of all the roots. In White Icicle with a mean of 47.59 grams, the largest class of individuals was at 30.5 grams, and constituted 12.31% of the whole population.

LENGTH AND THICKNESS VARY

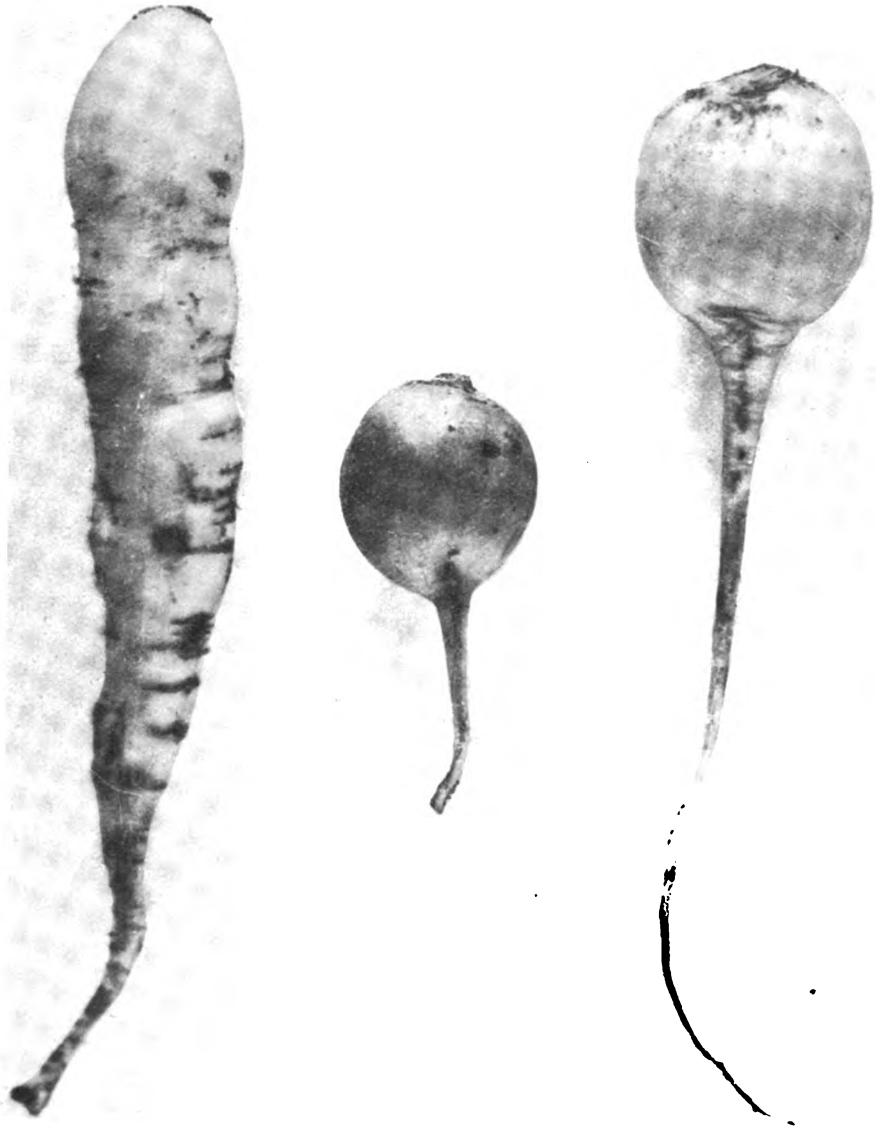
As to the length, we find the first two varieties both 25% variable, and the third one 27% variable. While the mean and mode run fairly close together in all cases, we find that only about 13% of the whole population in any case is approximately the same length as the average.

Essentially similar conditions exist in regard to thickness, and variability as to general shape runs from nearly 22% in White Box to as high as 90.39% in Scarlet Globe. This is a very undesirable condition in a crop that is grown to be harvested all at the same time, and where uniformity is an important feature in the attrativeness of a bunch of radishes in the market.

In order to ascertain which factor was more important in influencing weight, whether length or thickness, each of these dimensions was correlated with weight. As can be seen by the table (see appendix), width was far more important than length in Scarlet Globe and White Box, the coefficients of correlation being 88% and 90%, respectively, as against 65% and 82% when length was correlated with weight. Length was slightly the more influential factor in White Icicle, the long variety, as shown by correlation coefficients 88% for length as against 87% for width.

COMMERCIAL APPLICATION OF RESULTS

The results of this little study are interesting in the light they throw on the existing conditions of commercial varieties of one of our common vege-



THREE STANDARD COMMERCIAL VARIETIES OF RADISH

At left is a specimen of the long White Icicle variety. In the center is a White Box. On the right is a Scarlet Globe.
All are very variable but can be improved by scientific methods of election. (Fig. 10.)

tables. While it cannot be claimed that the constants here obtained would be found in other samples of seeds that might be obtained elsewhere or grown under different circumstances, or that they are approximately true for other varieties of radish, or other root crops, nevertheless, most growers of vegetables would admit, I believe, that conditions found in this study are fairly representative of general conditions in this group of vegetables. It is well known by growers that much of the seed planted is not viable, that a large portion of the crop is not true to type and must, therefore, be culled out as unmarketable, and that there is great variability as to rate of growth and time of maturity. If data were obtainable on quality and color of flesh, it is not to be doubted that the variability in those characters would be any less than in these here studied. It is realized that much is to be desired in constancy of all those characters upon which the commercial value of kinds and varieties of vegetables depend.

This excessive variability is easily to be explained by the methods of selection generally practiced by seed growers. Sometimes seed is saved from those plants which are most vigorous or first come into bloom (as was apparently the case in White Box), and seldom is careful attention given that the root shape be very true to ideal; moreover, mass selection is used, whereby the less desirable characters, often lying hidden and latent, are kept along with the most desirable characters of the best selected plants. There are two chief reasons why it is difficult to practice careful selection in such crops. First, that part of the plant where constancy to type is desirable lies out of sight in the ground. To dig and select these roots at the time they are marketable would be fatal and no seed could be obtained from them. In the second place, the plants, as grown for commercial seed production, are left to open pollination, with plenty of chance for cross pollination with poorer individuals or even with different varieties. This is a fault hard to obviate in commercial practice, because the radish does not readily set seed when the flowers are covered, and the flowers usually need manipulation to insure self-fertilization.

SUGGESTIONS FOR SELECTION OFFERED

The following suggestions are offered as possible and practicable methods of selection for securing better trueness to type in such crops. First, determine what is the ideal type as to shape, size, length of season, etc., for the particular kind and variety. Then carefully select a few plants which closely approximate this ideal at the time they should be ready for harvesting or for market. This could be done by removing the earth carefully from about the roots long enough to observe them and then quickly replacing it around those plants which are found to be close to standard. These only should be retained and allowed to set seed. Varieties likely to cross should not be planted near together. The seed from each of these selected plants should be sown in separate plats or rows, and no seed should be saved from this generation except from those plats or rows which show greatest constancy to the type for which their parent was selected.

Another method of breeding that might be suggested would be to grow the plants as pseudo-biennials; that is, to let the roots attain marketable size, then dry them off and dig them. They could then easily be measured, and could be stored until the beginning of the next growing season. It would be possible to do this under controlled greenhouse or irrigation conditions, or possibly, by planting so late in the season that growth would be checked at the right stage by the advent of cold weather. The seed obtained from these plants during their second growing season should be planted in separate rows or plats from each plant. The seed from all the plants in each row or plat might be harvested all together, but unless each row or plat subse-

quently proved to be uniform and close to standard, its seed should be discarded.

The general amount of variability might quickly be reduced if these methods were put into practice, and by repeating the selection of a few ideals individuals for several seasons and isolating them into separate plats or rows, a variety or strain of great constancy and perfection of type might be obtained.

Genetics in Relation to Agriculture[1]

Babcock and Clausen's New Book Reviewed

The object of the authors in preparing this book is well stated in the preface as an attempt at "an adequate presentation in a single text of the facts and principles of genetics and their practical applications." The reader will concede that in this attempt the authors have been successful to a very gratifying degree. They have done an immense amount of work in bringing together the results of investigations and have apparently omitted nothing of importance. While the book will be of transcendent value to the undergraduate student of genetics in that it will present to him the subject as a connected and logically arranged whole, the very complete manner in which the important work that has been done along this line is covered will make the work of preeminent value to the investigator.

The work of the authors is characterized by great care in stating facts and giving the opinions of others. It is gratifying to find, however, that they do not hesitate to state their own opinions on points which are in dispute. The fact that in doing this they are also able to give what appears to be an eminently fair statement of the arguments on both sides is a matter on which the authors deserve congratulation.

The authors of this book do not make the mistake of assuming that the science of genetics is the only phase of knowledge required by the successful breeder. They make clear to the student that the work of the breeder is an art which includes much more than a knowledge of the principles of genetics.

Considering the volume of the text, which covers more than 600 octavo pages without the glossary, list of literature and index, the number of errors in this first edition must be considered remarkably small.

The book is divided into three parts, the first of which deals with Fundamentals, the second with Plant Breeding, and the third with Animal Breeding. It must be conceded that this is the most adequate presentation of the subject of genetics that has yet appeared. Part III, on animal breeding, however, is not so adequate as the two preceding parts. While the scientific aspects of animal breeding are well presented, the text of this portion of the book is not characterized by the intimate knowledge of practical animal breeding shown in Part II on plant breeding. Nevertheless, it is a book which the practical breeder of animals cannot afford to be without.—W. J. SPILLMAN.

[1] By E. B. Babcock and R. E. Clausen. New York: McGraw-Hill Book Company. 1918. Pp. xx–675, 4 plates.

BUD VARIATION IN DAHLIAS

A. D. Shamel, *Riverside, California.*

Dahlias are propagated commercially by cuttings. They are sometimes propagated by division of the roots and by grafts. In a very limited way, mostly eperimentally, they are grown from seed.

There are a very large number of varieties of the dahlia in cultivation in the United States and abroad. Wilhelm Miller states, in Bailey's Cyclopedia of Horticulture, that over 3,000 different names of dahlia varieties have been published in catalogues. In this respect the dahlia resembles the chrysanthemum of which a very great number of varieties are listed in commercial catalogues.

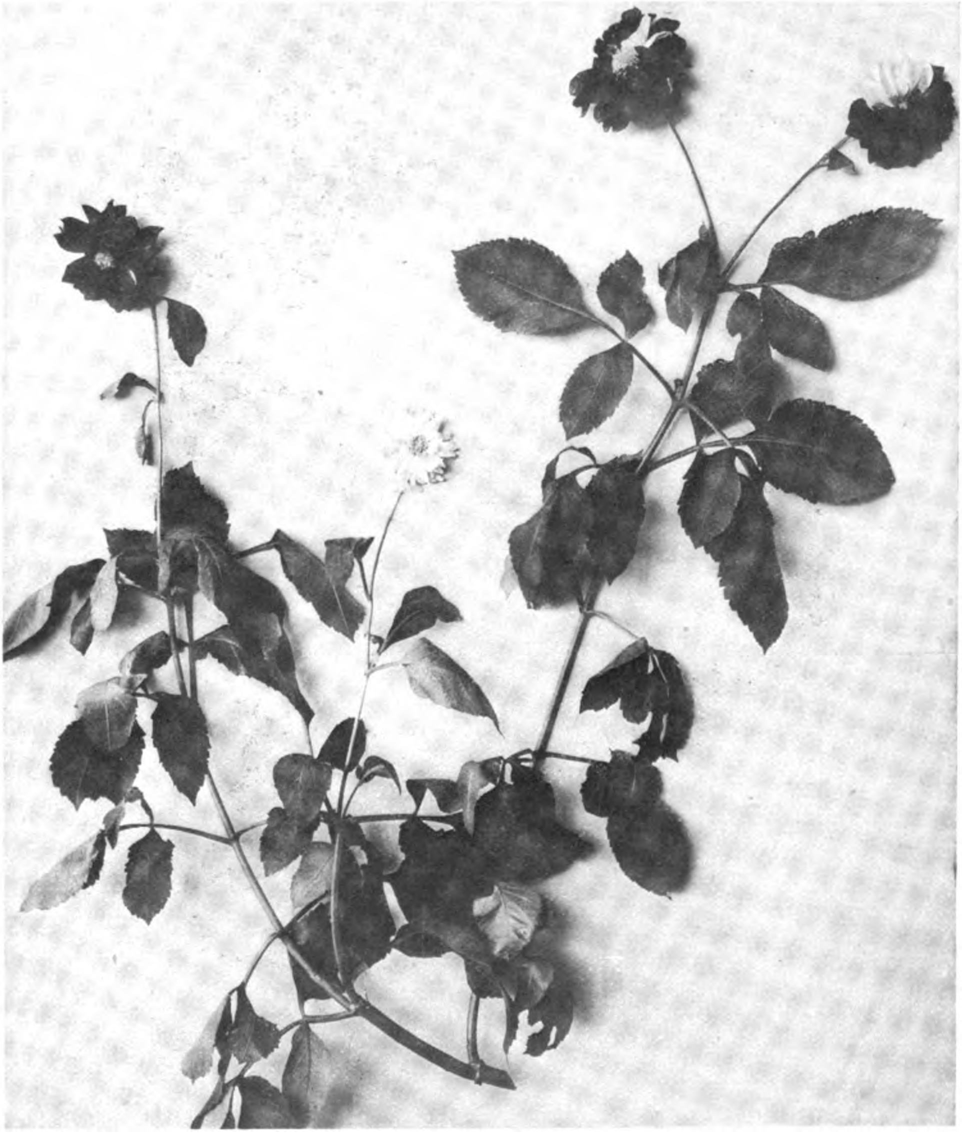
Some of the authors of discussions of dahlia varieties seem to have fallen into the error of assuming that the numerous varieties must of necessity have originated from seedlings. Such is not the case. The writer believes that bud variation has been responsible for the origin of many of the most valuable varieties of dahlias. Here again, the writer believes that the dahlia resembles the chrysanthemum. As pointed out by Cramer a great part of the cultivated varieties of chrysanthemums have originated from bud variations. The commercial methods of propagation of the dahlia and the chrysanthemum are similar. In both cases variable plants arising from cuttings have been propagated by growers. The beautiful and striking variations have been multiplied by the use of cuttings and introduced as distinct varieties.

Darwin states under his discussion of Bud Variation, "Dahlias propagated by tubers under the hot climate of St. Domingo vary much; Sir R. Schomburgk gives the case of the 'Butterfly variety' which the second year produced on the same plant double and single flowers; here white petals edged with maroon; there of a uniform deep maroon. Mr. Bree also mentions a plant 'which bore two different kinds of self-coloured flowers, as well as a third kind which partook of both colors beautifully intermixed.' (1832.) Another case is described of a dahlia with purple flowers which bore a white flower streaked with purple." (1842 and 1850.) It can be seen from the above statement that bud variation in the dahlia is no new or recent phenomenon.

From a recent inquiry (1918) amongst Southern California dahlia growers striking bud variations in dahlia plants propagated from cuttings, are said to be of common and frequent occurrence. Occasionally, two or more kinds of flowers occur in the same plant. In many cases local gardeners have isolated the interesting and valuable bud variations of the dahlia and propagated them as new varieties.

The facts are, that all of the varieties of local origin which the writer has investigated have been originally discovered as variable plants, or branches of plants, in plantings of established varieties. Therefore, they have originated from bud variations. It seems likely that a great many of the established varieties have originated in the same way, as is apparent from the manner of propagation. Therefore, bud variation has been a most important factor in the improvement of the dahlia.

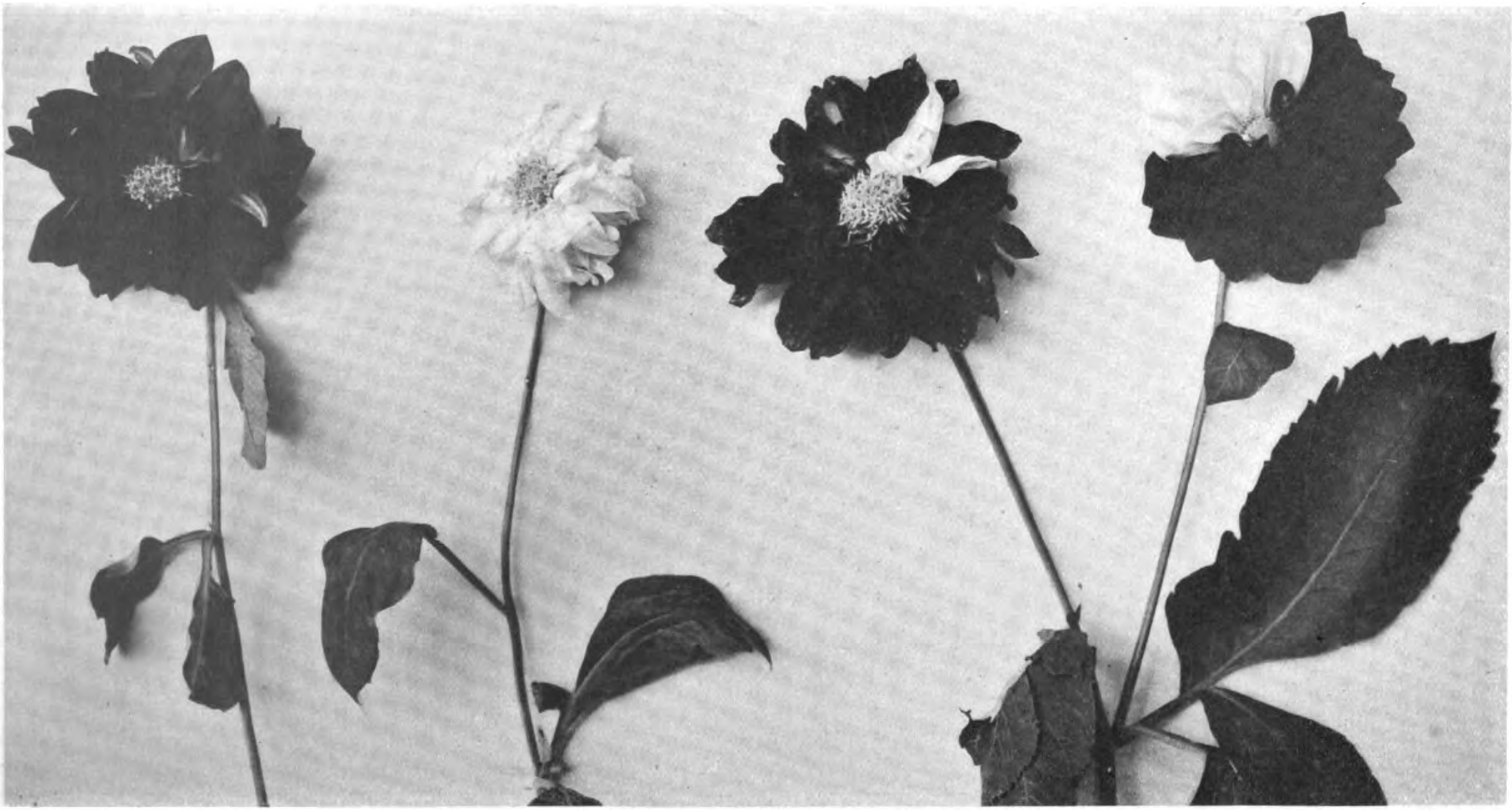
One of the striking bud variations of dahlia plants observed by the writer this season in Riverside is shown in Figs. 11 and 12. The name of the



CURIOUS MIXED-COLORED DAHLIAS

A dahlia plant bearing white, purple, and mixed white and purple flowers. The leaves also show interesting bud variations, varying from entire, two-parted, to three-parted forms. (Fig. 11.)

variety in which these interesting bud variations occurs is unknown. The plant illustrated in Fig. 11 has shown similar variability for five years. It grew from a cutting. There are three kinds of flowers borne by this plant, as can be seen in Fig. 11, pure white, purple, and mixed white and purple. In the mixed flowers some of the petals are almost exactly half white and half purple. The plant is perfectly healthy and vigorous in growth and the flowers are particularly beautiful and ornamental.



DAHLIAS OF VARIOUS COLORS ALL FROM ONE PLANT

Typical flowers from plant shown in Fig. 11. The form and arrangement of the petals in the white flowers are different from that of the purple flowers. The writer believes that bud variation has been responsible for the origin of the most valuable varieties of dahlias. (Fig. 12.)

EFFECT OF WAR ON CRIME, MARRIAGE AND INSANITY

War Decreases Crime and Insanity—It Increases the Marriage Rate, but Decreases Birth Rate and Also Infant Mortality—Its Effect on Illegitimacy

PROFESSOR J. A. LINDSAY has published in *The Eugenics Review* for October, 1918, some valuable facts bearing on the much discussed, and but little investigated question—the relation of war to eugenics. He first takes up the mere matter of the number of persons killed and the time necessary to repair the losses. Here Professor Lindsay quotes Savorgnan who published a detailed calculation in a recent number of *Scientia*, arriving at the conclusion that England will require ten years, Germany twelve, Italy thirty-eight and France sixty-six years before recoupment can be expected.

"It is probable that the views here expressed do not err on the side of optimism, and they serve to bring out in lurid light the vast holocaust of the nations which is now in progress. There has been nothing like it since the Black Death of the fourteenth century, which is believed to have carried off twenty-five million victims. F. Savorgnan's general conclusion is that about the year 1930 Germany and England will have made good their losses in man-power, but that Italy will require much longer, and that the prospect before France is very grave, as her population before the war was practically stationary. He thinks the difficulty of France will be partially met by a large immigration of Italians and Spaniards, who are traditionally prolific, and who will ally themselves with French women, the tendency being towards the formation of a solid Latin block.

"The population of England and Wales, according to the usual computation, increased a little more than a million in the course of the seventeenth century, nearly three millions in the course of the eighteenth century and no less than twenty-three millions in the course of the nineteenth century. If this rate of increase should continue, it is reckoned that 300 years hence England and Wales would have a population of 1,400,000,000! There is evidently here matter for serious thought."

THE MARRIAGE RATES INCREASE

"Closely related to the question of man-power, as affected by the war, are the questions of marriage rates, birth rates, and death rates. As regards the marriage rate, it is well known that in early days of the war "war marriages" were numerous and popular, the marriage rate for the quarter ending September 30, 1915, being the highest ever recorded for England and Wales, viz., 21.8 per 1,000, and for the whole year 19.4 per 1,000, as compared with 15.4 per 1,000, the average figure for the previous ten years. Sir Bernard Mallet has calculated that between August, 1914, and June, 1917, there were in England and Wales 200,000 people married who, but for the war, would have remained single, and in Scotland 8,000 such persons. In Ireland there was no increase in the marriage rate. The motives for war marriages are various and of varying degrees of validity. Sentiment, the outflow of female sympathy for men risking their lives, in the defense of their country, accounted for some. Parental caution regarding financial security was naturally less stringent in war time. But motives more definitely eugenic were also at work. The desire for heirs, fears for the extinction of ancient families—such motives operated and were worthy of respect. Naturally, the high marriage rate could not be maintained and soon tended to fall.

The rate for 1916 was 14.9 per 1,000, being 4.5 per 1,000 below the phenomenally high rate of 1915, and the figures for 1917, so far as they have been ascertained, indicate a further decline."

THE BIRTH RATE DECLINES

"War, for obvious reasons, tends to depress the birth rate. In invaded and devastated regions the whole machinery of family life is disorganized, and the birth rate falls to one-half or even less of the normal figure. This has been the case in parts of France, Poland, and elsewhere. In Bavaria the birth rate of 20.7 per 1,000 in 1913 fell to 15.8 per 1,000 in 1915. In England and Wales the rate of the last quarter of 1915 was 19.5 per 1,000, the lowest on record. Thereafter there was a rise in the rate, we may presume as the consequence of "war marriages," which for the quarter ending September 30, 1916, stood at 21.7 per 1,000. For the whole year 1916 the rate was 20.9 per 1,000, being 4.6 per 1,000 below the average of the decennium 1905-14, and 1.0 per 1,000 below the rate for 1915. Sir Bernard Mallet calculates the reduction of natality in this country due to the war at 12% in 1916, as compared with 1914, and points out that most of the belligerent countries have suffered much more severely. Whether the progressive decline in the birth rate which has been operative in this country for half a century will continue after the war cannot be affirmed with certainty, but probability points in that direction. How far this tendency is evil is a question upon which there is at present much difference of opinion."

INFANT MORTALITY DECREASES

"Infant mortality has shown a remarkable decline in England and Wales during the war. The rate for 1916 was 91 per 1,000 births, being 19 per 1,000 below the rate for the preceding year, and 22 per 1,000 below the average of the decennium 1906-15. Until we see whether this decline will be maintained, it is somewhat premature to speculate on its causes which are not clear."

"Experience in France after the war of 1870, and in America after the Civil War, shows that the diminution in crime in time of war is followed by a large recrudescence of crime in the after-war period. The causes of this increase are sufficiently obvious. The relaxation of military discipline, the reaction from the privations of war, the breaking up of homes, the uncertainty of employment, impatience with the monotony of industrial life—such factors are obvious and must be reckoned with as tending to crime. War is a good school of the virile virtues, but it is hardly a school to inculcate increased respect for the lives, property and rights of others."

JUVENILE DELINQUENTS

"While crime generally has notably declined during the war, it is disquieting to find that there has been an increase of juvenile delinquency. From England, Scotland, and France, there is the same report of an increase in the number of first offenders."

WAR DECREASES INSANITY

"A very unexpected feature of wartime has been the decline of insanity. That this decline is real and not merely statistical seems to be the opinion of those best qualified to judge. Robertson of Edinburgh is of opinion that the war has acted as a mental tonic. He could trace no increase in insanity due to the war, but regarded dabbling in spiritualism as dangerous to certain mental types. Easterbrook of Crichton Royal found only 19 cases of insanity due to "grief," and was of opinion that war had "only exposed and accentuated inherent weakness." Carre of Glasgow reported only nine cases of insanity due to the war. Robertson thought that the fall in the female statistics was due to women not being so "shut in" as before. Graham of Belfast reported a decrease in the number of insane and expressed the view that "it is not the great tragedies of life that sap the force of the brain and wreck the psychic organism. On the contrary, it is the small worries, the deadly monotony of a narrow and circumscribed existence."

The above facts admit of only one interpretation—viz., that war, fruitful though it is in shock cases and neurasthenia, does not increase, but may even tend to diminish, insanity.

WAR DECREASES SUICIDE

"A remarkable and unexpected result of the war has been a decided decline in the rate of suicide. In the ten years 1901-10, the average number of male suicides was 157 per million living. In 1914 the figure was 151 per million, while in 1915 the figure fell to 104 (civilians only), and in 1916 it stood at 111. Amongst females, as might be expected, the fluctuations were much less marked. The female rate in the decennium 1901-10 was 47 per million living, in 1914 and 1915 it was 45, and in 1916 it was 38. These figures are a further indication that the effect of the war upon the mental stability of the nation has been tonic, rather than depressant."

THE WAR AND ILLEGITIMACY

Another aspect of the war in relation to eugenics is treated by Emma O. Lundberg in an exhaustive article in the *American Journal of Physical Anthropology* for July-September, 1918.

The writer has gathered comparative data on the rates of legitimate and illegitimate births based, respectively, on the total number of married women, and the number of unmarried, widowed or divorced women in the various countries of Europe. "These figures are of interest as showing the trend of the general birth rate over a period of years, the illegitimacy birth rate over the same period, and a comparison of the two. The most striking thing brought out is the regularity of the absolute decline, not only of the legitimate birth rate, but of the illegitimacy rate as well. With the exception of Ireland, all the countries for which we have figures covering from 30 to 40 years, show a decrease in the number of legitimate births in comparison with the number of married women of the age inclusion. There was a similar decline in the ratio of illegitimate births to the number of unmarried women in all of the countries except France and Sweden; in the first of these countries the rates were stable, and in the second there was an increase. In Great Britain and Bavaria, while the rates indicate an increase, there was an actual decline in the number of illegitimate births. Other countries in which there has been a progressive decrease in the number of illegitimate births annually are Austria, Belgium, France, Great Britain, Italy, Norway, and the Netherlands. Increases in the annual number of illegitimate births during a thirty to forty year period have occurred in the German Empire as a whole, especially in Prussia, and in Bulgaria, Denmark, Finland, Bosnia and Herzogovina, Hungary, Portugal, Roumania, Russia in Europe, Serbia, Sweden, and Switzerland.

In the social changes that came when Europe was plunged into war, old customs were uprooted, the existing order was disturbed, and revolt against conservative ideals seemed likely to alter the standards that society had sanctioned. The economic and social relations of the sexes were altered; artificial distribution of population resulted from concentration of men in army camps; emotional disturbance was a part of the war excitement; the growing independence of women, economically and socially, forecast freedom from restraints. On the other hand, the added responsibilities and the seriousness of the times, the greater individual freedom of women, and the general absence of leisure time, might be presumed to have counteracted these conditions to a considerable extent. Also, we must take into account the increased number of marriages early in the war, and the large proportion of the men removed to the front.

In England the Registrar-General has called attention to the fact that the war has produced no perceptible effect on the statistics of illegitimate births, in spite of predictions current in the early months of the war.

THE TESTING OF A NEW TREE CROP FOR HARDINESS

David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, Washington, D. C.

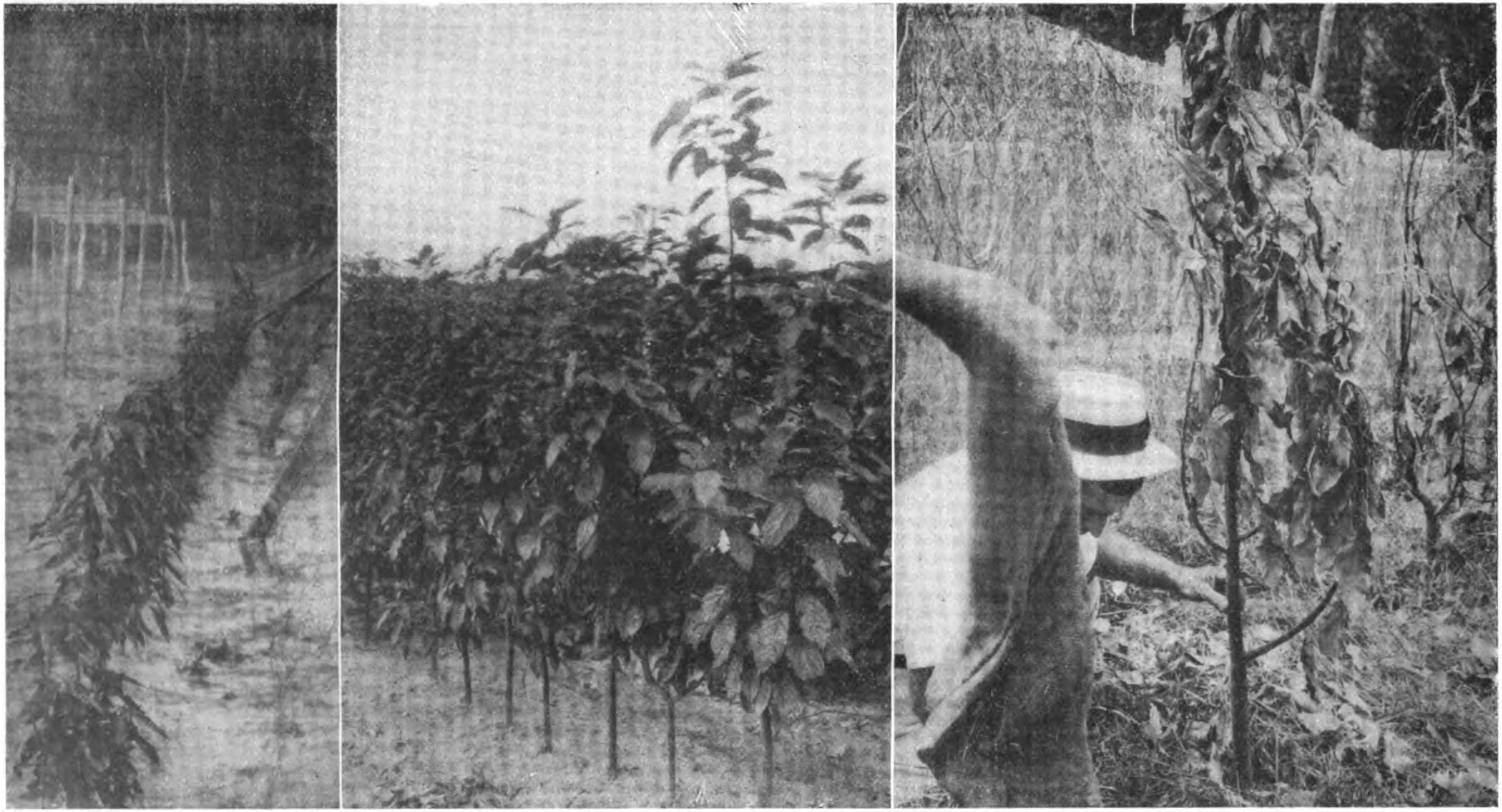
IN A REGION like that of the Gulf States where there is a great range in the minimum temperature from year to year, it is not a simple thing to determine whether a tree crop of some new introduction can be grown there or not. There are so many factors and they are so complicated and their solution runs away with so much of an investigator's life that it is almost a discouraging business to attempt to test out a new tree crop in a new region. It must be done though, and in the doing of it, those of us whose business it has been to do this kind of work are learning a few things which it seems to the writer are worthy of recording for the next generation of experimenters. This brief note is intended to cover only one feature of the difficulty which attends this kind of work, viz., that which has to do with the protection of the young plants through their babyhood and at the critical times when in our Gulf States in particular every new tree runs the supreme danger of death from freezing.

Young trees like young people are more tender than the grownups and the little baby trees, which, when they are fully grown will weather severe freezes, are often killed outright by light frosts and never get a chance to prove their ability to stand the cold.

Through a series of years those of us in the Office of Plant Introduction who are interested in the problem have been watching some experiments in the acclimatization in Northwestern Florida of the hardier or Mexican type of avocado.

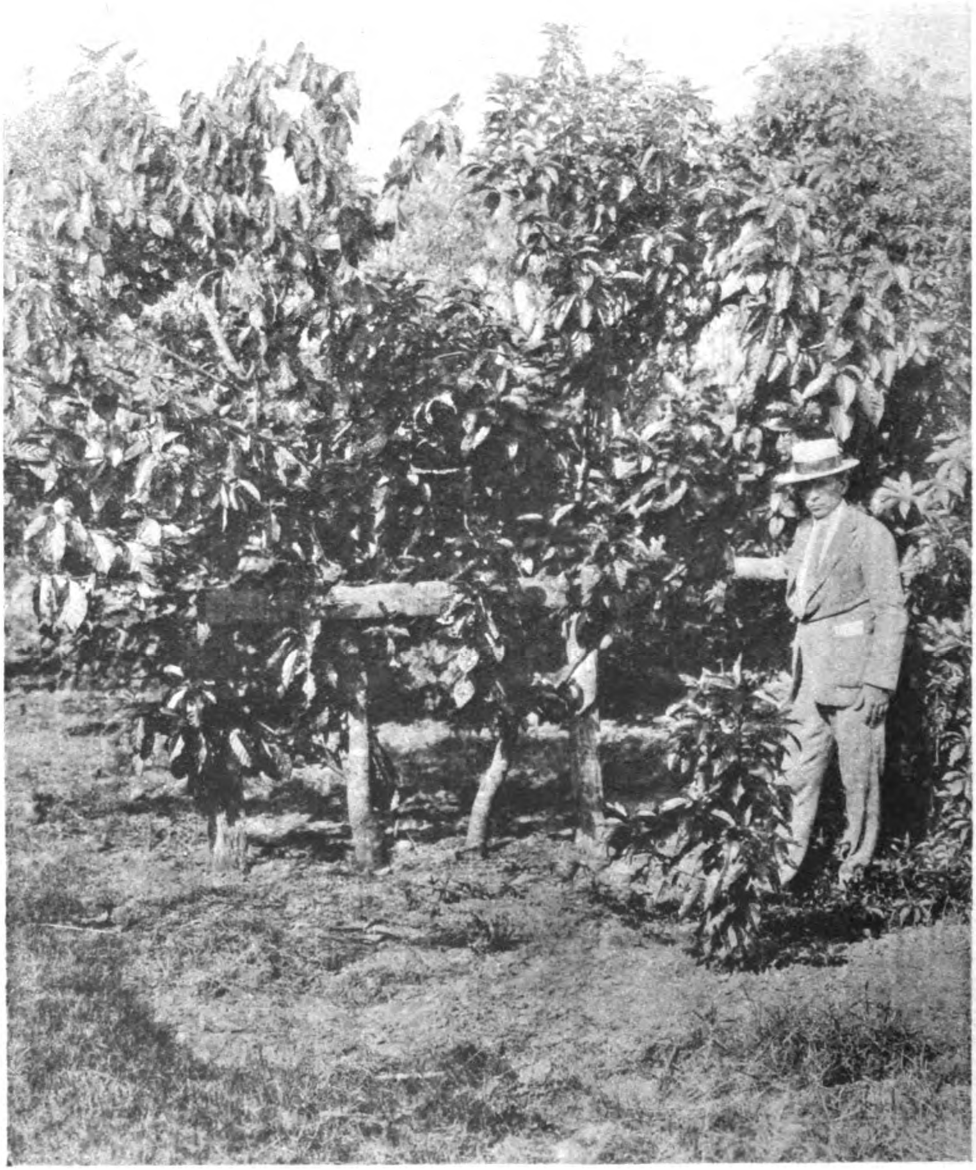
One of our field stations is located at Brooksville, in that remarkable hammock region of Western Florida where the soil conditions appear to be favorable for the growth of the avocado and it was at this station that the tests were made. The climate of Brooksville during all but a very brief period is of a character favorable to the growth of this tree, but there are short periods, usually in the month of February, when for a few nights the thermometer drops, if there is no wind, to even as low as 18° F. The temperature does not remain there for more than a few hours, but long enough to devastate a garden of tropical plants so completely as to discourage any but the real pioneer in plant introduction. It is a strange experience to wander through a garden upon which one has spent years of thought and labor and to find that during a few hours just before dawn the pets which were so promising and appeared in perfect health, have wilted and are actually dying before your eyes. This is the experience of the pioneer in plant introduction.

I remember in 1898 visiting West Palm Beach where my former professor of horticulture, Prof. E. Gale, had gone in the eighties to study the tropical mango during the last years of his life. He took me out into his little garden and showed me there the original Mulgoba mango tree which had been killed down to the ground on two occasions but which was at that time ten feet high, branching at the ground as all trees do which are cut back by the frost. I could not then fully appreciate Professor Gale's confidence in the future of the mango at Palm Beach and



TESTING THE HARDINESS OF THE TROPICAL AVOCADO TREE BY PROTECTING IT FROM FREEZING WHEN YOUNG

On left row of Mexican Avocado seedlings as they appeared after being injured severely February 20, 1916, by a temperature of +24° F. nine months after planting. Had the temperature gone a few degrees lower, these little trees would have perished in infancy. In middle: the same row after recovering and making a season's growth, *i. e.*, in November, 1916. On right: the same trees a few months later (February 2, 1917) after a freeze of +18° F. had killed back the trees to within a foot of the ground, notwithstanding the fact that they were protected with straw or hay and burlap wrapped around them (note covered tree in left hand corner). Had these not been protected they would have been killed by the lowest temperature which has visited the region in twenty years. (Fig. 13.)



AVOCADO TREES WHICH, AS A RESULT OF PROTECTION WHEN YOUNG, SURVIVED THE LOWEST TEMPERATURE OF TWENTY YEARS

These three Mexican Avocado trees are some of those shown in the previous plate. They prove what can be done in the way of bringing to maturity a tender tree on the northern border of its range, if frost protection is given to it at the right time. The right hand tree bloomed November 27, 1918, three years and six months after the seed was planted. (Fig. 14.)

it was not until ten years later that I visited the same spot and walked under this same Mulgoba mango tree the branches of which stretched ten feet above my head and the trunks of which were as large around as my thigh.

Professor Gale had coddled his little tree, and by protecting it during the freeze had kept it from being killed back quite to the ground, and when it became fully grown the freezes could not do more than severely prune it, for the thick bark and the protection of the branches were sufficient to keep out the cold from the growing inner bark or cambium.

This experiment established the practical limit of mango culture in Florida, and although the freezes come too often to make commercial mango-growing a profitable thing around Palm Beach there are hundreds of trees there and they bear delicious fruit.

In the case of the trial of the Mexican avocados which were planted at Brooksville and which went through two severe freezes, we have a rather complete photographic record and it is the main object of this note to publish these photographs and give some idea to those who have not had the experience themselves, of how a little care given to a row of seedlings is repaid by the growth of good trees which stand a chance of weathering the severest weather of the region. In June of 1915 there were sent to the Brooksville garden a hundred or so seedling trees only a few inches tall and they were put out in a nursery row. Arrangements were made to protect them during the following winter but the man in charge of the garden was not familiar with the climate and he failed to cover them and the result was that although the thermometer went down to only 24° F. at the garden, which will not injure the Mexican avocado when fully grown, a large share of the little plants succumbed and the rest were severely cut back. On February 20, 1916, immediately after this first freeze, they appeared as shown in Fig. 13.

During the following summer these trees grew and made a strong, vigorous growth and by the following November appeared as in Fig. 14.

These young trees were already large enough to excite attention and when the danger season approached Mr. J. E. Morrow who in the interim had taken charge of them saw to it that they were thoroughly wrapped with straw and over this straw a wrapping of burlap was put as shown in Fig. 13. The temperature went this time to 18° F. and killed outright every tree in the row which had not been properly wrapped to protect it and even with the protection afforded by the burlap and the straw these young trees were killed back to a foot or two above the ground (Mr. Morrow's thumb in Fig. 13 marks the height of the living wood as it appeared on February 2, 1917). By the following December these trees had made a very rapid growth and one of them appeared as shown in Fig. 14 which was made from a photograph taken December 17.

In the course of the following summer this tree had grown into a good-sized specimen, one which any owner would have been proud of and it stands a really good chance during the coming winter of weathering any freeze which is at all likely to visit the region. Owing to the nursing care which Mr. Morrow gave to these seedling avocado trees we have now arrived at a positive result which is a very different thing from the ordinary negative result which might for years have discouraged anyone from even the attempt to grow the Mexican avocado as far north as this point on the west coast of Florida.

In the early days of Florida there were thousands of failures reported. It was always a difficult matter to sift out those which really indicated an unsuitability of the plant to the climate from those which merely represented infant mortality through neglect to protect during the danger period.

Environmental Factors and Hereditary Differences Influencing Fruiting of Cotton

IN 1911, observations were begun by E. C. Ewing at the Mississippi Experiment Station in a study of the processes by which the fruit is normally set and matured in American Upland cotton in that locality. "The project also contemplated a study of the differences in the fruiting processes displayed by different varieties growing under similar conditions. The object of the investigation was to obtain a better understanding of the seasonal history of the cotton plant for consideration in the light of the information already available in regard to the life history and habits of the cotton boll weevil, and especially to determine the nature of varietal differences in the fruiting processes. In the same year experiments were started with the view to the improvement of varieties and the production of new varieties for culture under boll weevil conditions. This effort to take stock of the material and qualities available in the existing varieties then appeared essential for the proposed cotton-breeding work.

"The fact that boll weevils usually emerge from hibernation in numbers relatively small as compared with the numbers appearing in late summer and fall and that only the early fruit can mature uninjured in infested fields, pointed in the early experiences with the boll weevil to the importance of earliness as a varietal characteristic in cotton to be grown under boll weevil conditions. But from the nature of the cotton plant it became evident that earliness is a rather indefinite matter, that hereditary qualities might contribute to earliness, and that these qualities might be closely related or might be independent of one another. These and numerous other collateral questions have been studied, and the results and conclusions are comprised in this report. [*Technical Bulletin*, No. 8, Agricultural College, Mississippi, June, 1918, pp. 93.]

THE QUESTION OF EARLINESS

"The effects of external influences, including certain cultural factors, have been referred to under several headings, and the hereditary qualities which constitute varietal differences in earliness have been discussed to some extent. In that discussion it was pointed out that a variety might be early in one way and late in another. For example, two varieties planted and grown alike may produce their first flowers on the same date, in which case they are equally early in one phase of earliness, initial flowering. But more time may be required for the bolls of one of these varieties to develop than for those of the other. If the mean boll period at the beginning of the fruiting season is forty-five days for one variety and fifty days for another, then the first bolls of the former should open five days earlier than those of the latter, although the first flowers appeared simultaneously in both varieties. Then the amount of fruit set within a given period, say thirty days after flowering begins, depends first on the mean rate of flowering, one or two or three flowers per day as the case may be, and second, on the percentage of these flowers lost through shedding. The last two factors also, of course, help to determine the rate at which the bolls open in the autumn and the relative earliness of the crop of any variety. Thus, these four factors, the time of commencement of flowering, the length of the developmental period of the boll, the rapidity of flowering, or the daily rate of flower production, and the percentage of shedding, together with the mean, yield per boll, are all more or less related to the question of weevil injury and weevil

avoidance; therefore, each helps to determine the amount of the crop which will be matured by a certain date in the autumn.

THE QUESTION OF HEREDITY

"In our attempt at an analysis of the hereditary factors concerned in earliness all these factors have been studied independently and in their combined effects. It now remains to record in detail the differences which have been found in fruiting activity of the several varieties studied.

"These studies have not included any observations on the growth of the plant. Our attention has first been centered on the question of the time of opening of the first flower in the several varieties planted and grown under as nearly identical conditions as is possible with the usual methods of variety testing. With the appearance of the first flower in each variety the daily counting of all flowers produced by each variety was started. The number of plants of each variety studied was one hundred. These were divided equally among two rows of adjacent series, the varieties being planted in multiple series, each series consisting of as many parallel rows as there were varieties. Thus, in 1914, ten varieties were studied, and these were grown in twenty parallel rows, one thousand plants in all, one hundred of each variety, fifty to a row. This flower census was continued each day throughout the principal flowering season, each year from 1911 to 1914. The differences found in the flowering characteristics of the several varieties have reappeared rather consistently in the different years.

"During four seasons, 1911 to 1914, statistical studies have been made of the various fruiting process, but, as has been stated, the data obtained in 1913 have not been used for comparing varieties. In each of the other three years we have compared varieties of three groups: First, the so-called Early group, represented by such varieties as King and Simpkins, in which we have included the Trice variety; second, the so-called Big Boll group, of which Triumph and Cleveland are typical representatives; and, third, the Long Staple group, to which Columbia and Sunflower are referred. This grouping is that devised by Duggar (7)[1] and elaborated by Tyler (15),[2] and generally followed by agronomists working on American Upland cotton. No system of grouping, without an almost indefinitely large number of groups, can be made to include at once certain varieties and to exclude all others. This is due to the fortunate circumstance that certain of the dominant characteristics of the several groups are not so correlated as to be mutually exclusive. For instance, there is nothing necessarily to prevent a variety from combining the distinctive qualities of both the Big Boll type and the Long Staple type; in fact, Columbia and a few other varieties might qualify for either of these groups. Likewise it appears that a variety may be early in its fruiting habits and at the same time produce a long staple, although it has generally been believed in the past that Long Staple varieties were necessarily late in maturing their crop and slow in setting their fruit. The Express variety is one which resembles the Early group in its fruiting characteristics, and at the same time its lint is long enough to qualify for the Long Staple group. Cotton breeders are endeavoring with some success to break down negative correlations as far as they tend to oppose the combination of certain useful qualities.

"Obviously no variety combines all the good qualities in a high degree. Varieties are strong in some respects and weak in others. In choosing from the available varieties for the best cotton to grow, one can only take the kind that possesses the most advantageous combinations of qualities, but any variety selected necessarily will have some

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[1] Duggar, J. F.: Description and Classification of American Upland Cotton, Alabama Experiment Station Bulletin No. 140, 1907.

[2] Tyler, F. L.: Varieties of American Upland Cotton, U. S. Department of Agriculture Bureau Plant, Indiana, Bulletin 163, 1910.

defects. The best way to determine what varieties possess the most effective combination of character for culture under weevil conditions is to study the results of variety tests conducted under weevil conditions. These studies reported here were made mainly in advance of the weevil infestation in Mississippi, partly with the idea in view of predicting what varieties would be most efficient in lint production in the face of weevil attack.

"Now that we have several years' experience with the weevil, these results help to explain why certain varieties are more productive under weevil conditions than others. For this reason they should be of value to the cotton breeder. It was mainly as an aid to the plans contemplated by the Mississippi Experiment Station for attempting to develop more desirable varieties by hybridization that this analysis of the fruiting processes was undertaken. The results here presented show in what varieties or in what types certain qualities may be found. Experience in field comparison of varieties and in conducting variety tests should, with the aid of these results, enable the observer to form a fairly good estimate of the important characteristics of different varieties and of the degree in which they possess certain qualities, without having to resort to detailed and laborious studies, such as these have been.

"How much can be accomplished towards the combination of the several desirable qualities of different varieties through hybridization is another question. Partial successes already obtained in this direction are a favorable indication."

Disease and Natural Selection

While it is usually assumed that various race poisons have a disgenic effect upon mankind, it has been occasionally pointed out that the effect of alcohol and venereal diseases is, in the long run, a selective process, tending to eliminate the socially and morally unfit. This latter theory is based upon the belief that the morally inferior tend, on the average, often to acquire diseases leading to sterility. In other words, there is a correlation between morality and total net offspring.

Figures supporting this idea have been very meager. For this reason a portion of the report of H. C. and M. A. Soloman, published in *Mental Hygiene*, for January, 1918, and reprinted in the Bulletin of the Massachusetts Commission on Mental Diseases (Vol. II, No. 1), has considerable interest for eugenists. These writers have been making extensive investigations into the families of the neurosyphilitic and counting the number of children born in such families. Their conclusions follow:

"No greater cause of race suicide can be imagined than syphilis. For example, of the group of 247 families eighty-four, or 34%, were sterile—had no children; of the 160 families of paretics fifty-three, or 33%, had no children. In the population at large the least productive group as to children is supposed to be the college-trained, but we find among the Harvard and Yale graduates only from 19 to 23% of infertile marriages in contrast to the 33% among paretics. It was found, further, that 20% of the families had abortions, miscarriages and stillbirths, while dead children occurred also in 20%.

"As a result we find the average of living children per family to be 1.3, a figure very much lower than necessary to keep the population stable. The figures are about the same for families in which the original patient had or had not nervous system involvement. The birth rate for the 247 families averages 1.7 children. From the United States census report it is found that the average birth rate in our vicinity is 4.4 children per family. But this difference between 1.7 and 4.4 does not tell the whole story. Were it not for syphilis the 4.4 figure would be higher, for that average includes the syphilitics. But of the 1.3 living children per family, many are afflicted with syphilis and will have a shortened life and a lessened efficiency."

ROSEN RYE[1]

Heavy Yielding Variety Brought by Russian Student—Farmers Cooperate with Scientists in Keeping Up the Standard

FRANK A. SPRAGG, *Plant Breeder*, and J. W. NICOLSON, *Extension Specialist*. *Michigan Agricultural College, East Lansing, Mich.*

THE Rosen Rye has a shorter, stiffer straw than is ordinary and yields about twice as many bushels per acre as the old-fashioned common varieties, because the Rosen heads are much larger and better filled. The head is not longer than the common rye, but gains in size and weight through width and density. Rye is four rowed, *i. e.*, two flowers at each joint of the rachis, alternating on the head. In the case of the common varieties only about half of these flowers are fertilized, giving a rough, loose appearance to the head. The kernels of the common rye are small and usually covered by the chaff, while in the Rosen Rye the large kernels project beyond the glumes when ripe. Typical Rosen Rye has less than 30 per cent of its heads, with 10 per cent of the grains missing. The result is that the flowers are generally fertilized on most of the heads. This gives the crop a large, square-headed appearance. In favorable years, nearly complete fertilization may extend to 99 per cent of the heads.

Rye, as will probably be remembered, is open-fertile. This accounts for the irregularity observed in the above description. In the case of autogamons (close-fertile) plants, the crop becomes a mixture of homozygotes which are easily isolated by selection and pure-line breeding. The breeding problem in rye is that of corn in most details.

The first of this rye was planted at M. A. C. (East Lansing), in the fall of 1909. The Michigan Experiment Station was not long in observing the vast superiority of Rosen Rye over all others, and since it has been introduced among farmers, several have reported yields over fifty bushels per acre.

Developing and maintaining a pure strain of rye is one of the most difficut problems of a plant breeder, for rye, unlike most of the other cereals, such as wheat, oats and barley, cross fertilizes—resembling corn in this characteristic. The Danish people grow their pure seed on an island off the mainland. If we expect to keep our Rosen Rye pure we should grow it a quarter of a mile from common rye.

Rosen Rye was selected and improved from an envelope of Russian Rye, furnished in 1909 by Mr. Rosen, a student from Russia at the Michigan Agricultural College. This variety immediately began to show its outstanding superiority, and after proving its ability to double the yields obtainable with any other variety, it was distributed in a number of counties, and, where kept pure, is continuing to maintain the record established on the Experiment Station plants.

In 1912 a bushel of Rosen Rye was sent to Mr. Carlton Horton of Albion. This was sown on an acre and produced 35 bushels of rye of such quality that not only that crop but those of following years have been used entirely for seed. Now we find 2,000 acres growing in Jackson County, and 3,500 acres in St. Joseph County, with a total for the state of about 15,000 acres.

Unfortunately, due to ordinary threshing practices and the growing of common rye in adjoining fields, only about 5 per cent of this acreage is 99 per cent pure. The other 95 per cent has

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[1] A part of this report appeared in the *Extension Series*, published by the Michigan Agricultural College, July, 1917.

ROZEN RYE, GOOD AND BAD

The two heads in the center show a side and edge view of Rosen Rye. The two heads at the left show an edge and side view of common rye. The two heads at the right represent what is known by the inspectors as the off-type. This shows the large kernels of the Rosen and the poor filling of the common. This type results from a cross. (Fig. 15.)

been more or less crossed, and though it is increasing yields five to ten bushels per acre and should be used in preference to common rye, yet it cannot be considered equivalent to pure Rosen Rye.

The farmer who grows common rye knows that fifteen bushels per acre is all he can expect in an average year, with twenty bushels per acre as an exceptionally good yield. Yet the farmers who have had experience with pure Rosen Rye will agree that twenty bushels is a low yield for the variety, and that forty to forty-five bushels per acre yields are not uncommon.

Rye does not belong on every farm, but it is particularly adapted to large areas of the lighter soils of this state. To prevent washing and leaching, these soils should not be permitted to go through the fall and winter without a growing crop of some kind. In nearly every case, the thirty-five to forty-bushel yields of Rosen Rye have been obtained from fields sown during the first half of September. While it is far from our desire to advocate late sowing of rye, yet this crop can be used to advantage on thousands of Michigan acres to follow crops of corn and beans.

Now that Rosen Rye has asserted its superiority in nearly every rye-producing section and will yield over 300,000 bushels in the state during 1917, it should largely supplant all other varieties after that date, for ordinarily Michigan grows about 300,000 acres of rye; but this year (1917) there will probably be twice or thrice that acreage sown. If this occurs, many will be unable to get even Rosen Rye that is somewhat mixed, but by next year (1918) Michigan will not only be the leading rye-producing state, but she will double the four and a half million yield

A NEW BREED OF RYE. FARMERS COOPERATE WITH SCIENTISTS

Upper photograph shows a field of Rosen Rye. Note the larger heads on shorter straw than is ordinary in common varieties.
Lower photograph: Mr. J. W. Nicolson, Secretary, Michigan Crop Improvement Association, inspecting farmers' grain samples. The farmers, whose fields pass inspection, send a sample and promise the rest of the seed sold under the Association shall be up to this standard. (Fig. 16.)

now credited her, largely through the use of the variety Rosen Rye.

However, we should not neglect all the other factors which enter into the production of a good crop of rye, such as proper use of manure, acid phosphate, and thorough preparation of the seed-bed. For a maximum crop of Rosen Rye, seeding should be done the first half of September at the rate of four to five pecks per acre. October seeding should be made at the rate of six pecks per acre.

Realizing the value of the variety and the necessity for high standards of purity and freedom from weeds, the Michigan Crop Improvement Association has introduced an inspection of this and other pedigreed grains. Any farmer can become a member of this association on payment of the annual dues of one dollar, but in order to sell his grain under the trademark of the association, he must submit it to inspection by its agents and pay all attendant costs. The requirements to pass inspection include a clause demanding 99% purity of variety, freedom from quack grass, mustard and dodder, and not to exceed one-half of 1% weed seeds. To sum it up, inspected Rosen Rye must be good, pure, and thoroughly recleaned seed.

Lists of growers whose Rosen Rye has passed field inspection will be available August 1, 1917, and can be secured on request from J. W. Nicolson, Secretary of Michigan Crop Improvement Association. On receipt of this list, a prospective buyer can get in touch with producers of Rosen Rye.

Further Evidence that "Like Marries Like"

Donald M. Marvin has published in the September number of the *Publications of the American Statistical Association* some new facts confirming the theory that "like tends to mate with like." His chief conclusions are here quoted:

"The presence of a large and increasing number of women in industry raises the question of the possible influence of industry upon marriage selection. Modern social conventions are based upon the presumption that woman is shut away in the home and that man must follow her there if he wishes to see her. In entering industry in such large numbers, women face two new conditions, one negative, the other positive. They leave the home temporarily empty and they create a new social phenomenon of occupational propinquity. This, modified by the various influences of class stratification, financial status, and other forms of group cohesion involved in the present organization of society, tends to differentiate certain groups of men and women for marriage.

"Industrial propinquity extends to the home and to the economic status. Even class and race lines enforce occupational cohesion. Such stratification and drawing together of certain parts of social groups must react variously upon those involved. It seems possible that friends who marry within their own occupation are not so much guided by similar tastes and backgrounds as they are driven by a new force of industrial propinquity, a force that has developed with the appearance of woman in industry.

"Marriage, a matter of individual choice, if choice exists, obeys the sweeping silent force of propinquity. Women in each occupation are surrounded by the men of the same occupation. Of course they marry these men. This inevitable sequence causes no astonishment.

"Today the most attractive as well as the strongest and most vigorous women are in industry. Their presence has been accepted and the taboo has been removed. The result is that men are now marrying the women whom they meet in their work. The tremendous proportions of this movement are of startling and far-reaching significance.

"The data were derived from the

books of the Marriage License Bureau in City Hall in Philadelphia. All licenses in the available books were used. They include practically all licenses issued in Philadelphia for the three years from June, 1913 to June, 1916. The numbers run from 299,758 to 322,586 and from 332,601 to 340,900 and from 341,401 to 355,367.

"The grouping of occupations of the United States Census was used in a preliminary study of a thousand cases. Of these thousand cases 541 women worked and of these 275, more than half, married men in the same occupation. Of the thousand men more than 25% married into their own occupation.

"If a girl enters a profession, there is one probability in four that she will marry a professional man and small likelihood that she will marry into manufacturing. Ability to predict the occupation of the man whom a woman will marry may well be regarded as belonging in the realm of clairvoyance. Yet, while it will always be impossible to prophesy for an individual woman, for a group of women such prediction is not only easy but extremely accurate.

"A supplementary investigation was made of statistics of Bryn Mawr alumnae. It was found that about 90% of the married alumnae had married college graduates. More than 60% of them married men in professions.

"Where men and women are employed together in like positions, each profession or specialized occupation is the natural breeding place for people of the type of ability required. This situation must be recognized both by those who believe in heredity and by those who favor environment. Sex propinquity in modern industry seems destined to affect the matings and through the matings, the type of the coming generations."

League for Constructive Immigration Legislation

The fundamental principles of the proposed League for Constructive Immigration Legislation will doubtless be of interest to all patriotic Americans, and especially to believers in the importance of heredity and consequently in the inborn nature of important racial differences. The following suggestions have been received from Mr. Gulick:

The United States should so regulate, and where necessary, restrict immigration as to provide that only so many immigrants of each race or people may be admitted as can be wholesomely Americanized.

The number of those individuals of each race or people already in the United States *who have become Americanized* affords the best basis of the measure for the further immigration of that people.

American standards of living should be protected from the dangerous economic competition of immigrants whether from Europe or from Asia.

Such provisions for the care of aliens residing among us should be made as will promote their rapid and genuine Americanization and thus maintain intact our democratic institutions and national unity.

The Federal Government should be empowered by Congress to protect the lives and property of aliens.

All legislation dealing with immigration and with resident aliens should be based on justice and good will as well as on economic and political considerations.

Under suitable provisions and rigid limitations as to numbers and qualifications, naturalization should be given to all who qualify, regardless of race.

Correspondence on the part of those who approve these principles is cordially invited.

Sidney L. Gulick, *Secretary*,
105 East 22d Street, New York City.

HEREDITY OF TUMORS OF THE NERVES

Another Alleged Mendelian Dominant in Man

DR. SAMUEL A. PREISER of Montefiore Home and Hospital, New York, and Dr. Charles B. Davenport of Cold Spring Harbor, N. Y., have published in the *American Journal of Medical Sciences*, for October, 1918, some evidence, interpreted by them to mean that the rare disease, known as multiple neurofibromatosis (von Recklinghausen's disease), is inherited as a Mendelian dominant.

"Among the rarest of abnormal conditions of the surface of the body is that characterized by a large number of sessile or pedunculated swellings or tumors, sometimes soft and elastic, sometimes firm and tough, that vary in size from that of a millet-seed to that of a child's head. The skin over the tumors is frequently discolored, brownish or bluish, or redish through enlarged capillaries. They may be present from birth and they may tend to grow, usually very slowly, but they rarely, if ever, regress in size. Examination shows that they are fibrous tumors, frequently containing one or more nerve fibers; or, when more deep-seated, being enlargements of the perineurium of the nerve trunks. They are due to localized cell proliferation of the connective-tissue sheaths of the nerves.

"The number of these nodules varies with age and constitution of the individual. They tend to increase in number, as well as in size, with age. At one extreme there may be only a solitary growth upon one nerve, at the other the number is very great. Thus, Robert Smith (1849) counted 450 on one limb and over 2,000 on the whole body. Octerlong (1875) counted 2,333 tumors on a negress of sixty-six years and the count did not include some of the smaller ones. But the record of patience in counting seems to be held by Hashimoto (1890), who made out 4,503 tumors on the skin of a middle-aged Japanese man.

"Multiple neurofibromatosis is a rare condition, as it is found in only about 1 in 2,000 cases that present themselves to medical clinics or private practitioners for skin diseases. No doubt there are many abortive cases which never get into the literature, but, even so, the proportion of the population which has the classical symptoms of neurofibromatosis is very small. Despite this there are many cases in the literature of two to six members of a family — blood relatives — who show some of the symptoms. The frequent concurrence of these relatively rare symptoms in several members of one family cannot be accidental. It must be due either to the presence in the family of internal factors tending to induce the symptoms or to external agencies (such as contamination, germinal infection) which act upon individuals (like those of a family) who are in intimate contact. The fact that only *blood* relatives are affected speaks strongly against the contact hypothesis. The possibility of an infection through the germ cells cannot be denied. It is to be noted, however, that father and child are quite as often affected in the same way as mother and child. This proves that the tumors do not belong to the class of diseases that are induced merely by infection through the placenta.

"Though so many cases are on record of more than one affected person in a family, it is not to be overlooked that in very many reports no mention is made of relatives who have similar symptoms with the patient; also, there are a number of cases in which the existence of affected relatives was denied.

"An apparent difficulty in the way of the hypothesis that multiple neurofibromatosis is a dominant trait seems to lie

in the fact that breaks in generations actually do occur. That 'no family history' of a direct ancestor is obtained in response to the usual superficial inquiries made by the practitioner of hospital cases is not surprising; the fact that a disease like his own occurs in other members of the family is apt to be denied (if indeed recalled) by the patient under the stressful conditions of the examination; the patient often exhibits the reactions of the malingerer. In a few histories like that of Fig. 29, II, 2 [see full report; this, by the way, is a case of elephantiosis], it seems probable that a generation is actually skipped. This is by no means fatal to the view that the disease depends upon a dominant trait, for a precisely similar result is obtained in experimental breeding of clear dominant traits, *e. g.*, in polydactylism of fowl. Occasionally a dominant trait simply fails of expression in an individual who carries it."

The evidence that multiple neurofibromatosis is due to heredity is very convincing and it appears to be clear that it is associated with a segregation in the gametes, but the authors have failed to furnish proof for their theory that it behaves as a Mendelian dominant.

That same form of heredity is a cause of the disease is made evident chiefly by the fact that it is so very rare and at the same time cases occur so frequently grouped in the same families.

Chronic renal troubles and cancer may be just as much determined by faulty germ-plasm, as brachydactylism or night blindness, but the two latter conditions are so unusual that their appearance in several members of the same family is at once noticed, and properly ascribed to heredity. Multiple neurofibromatosis is also an extremely rare disease. The authors find 243 persons described in the literature of the subject. One hundred and fifty-eight cases show one parent similarly affected. In thirty-four cases neither parent is recorded as affected. This leaves fifty-one cases which were left out by the authors in their "families charted." Just how these surplus cases are dealt with is not made clear, but it is not very important as far as making certain the fact that the disease is due in most instances, if not in all, to some quality conveyed by the chromosomes. Even if there be only 158 cases out of 243 who are the direct descendants of others similarly affected, it is over 65%, and this, it must be remembered, is very high, considering the rarity of the ailment. Probably in the cases of neurofibromatosis many of the remaining 35% can be accounted for by lack of complete family data, that would show reversion to germ-plasm carried in the stock. Others may be new mutations. Further evidence must be produced that this curious disease does not often skip a generation, if it is to be included among the comparatively few cases of undoubted Mendelian dominance in man.

Sheep-Killing Habit Among Dogs Incurable and Infectious[1]

"The continued high prices of mutton and lamb have made it desirable that more sheep be kept on the farms of the United States. The excessive area of rough pasture land, weedy lots, and grown-up fence rows affords an excellent opportunity for feeding sheep, which should be used in cleaning up and maintaining the productivity of all such lands. Compared with the United Kingdom, where there is one sheep or lamb for each 2.5 acres of the total land area, in the 37 farm states of the United Sates, not included in the western division, there is only one sheep or lamp for each 31.8 acres

[1] Condensed from *Farmer's Bulletin 652*, Bureau of Animal Industry, U. S. Department of Agriculture.

THE WORK OF TWO DOGS IN A SINGLE NIGHT

Photograph shows fifty sheep killed by two dogs, during the night of February 8, 1917, in Beaver County, Penna. These sheep were valued at $1,000. Thirty-eight were ewes with lamb. Only four of the flock escaped. These were badly mangled. Photo by E. W. Brown, Beaver, Pa. (Fig. 17.)

of land in farms. The British farmer handles his land on an intensive farming basis, and forage-crop pasturages have been highly developed. In that country the special advantage of this system of pasturage for sheep is generally recognized.

"Forage-crop pastures not only augment intensified farming and increase the fertility of the land, but also free the sheep from many internal parasites contracted through grazing upon permanent pastures. Of such parasites stomach worms are most prevalent and disastrous with young stock. Methods of preventing infection through the use of a succession of forage-crop pastures are understood and successfully followed by many farmers. In flocks handled under such conditions lambs born in the late winter or early spring are kept free from infection and finished for the market by the latter part of June or the 1st of July, at which time market prices are generally highest. It is essential that the American farmer recognize the small flock of sheep, handled under forage-crop conditions, as a factor in the economic handling of high-priced farm lands.

"As compared with the census of 1900, that of 1910 shows an increased valuation of 20%, or approximately $19,000,000, in the total value of sheep in the United States, exclusive of the western division. Notwithstanding this marked increase in value, there was a decrease in numbers of 14%, or over 3,900,000 head, for the same period of time. It seems that an industry so favored by market conditions and so well adapted to the area in question should flourish rather than decline.

DOGS THE DIFFICULTY

"Sheep-killing dogs are not only recognized as the worst enemy of eastern flockmasters at the present time, but are known to be the principal cause of so marked a decrease in the numbers of sheep kept on farms. The moral effect upon all persons who have seen sheep killed, injured, or frightened by dogs is far more destructive to the industry than the actual damage sustained. No farmer contemplating the raising of sheep is likely to venture on the enterprise while the flocks of his neighbors are continually meeting reverses through the attacks of dogs, as the ultimate financial losses following such reverses are incalculable. Dog depredations to flocks are not only disheartening and discouraging to the flockmaster, but they also break up breeding plans and render flocks restless and non-productive.

USUALLY WORK IN GROUPS

"Sheep-killing dogs work both singly and in groups, but usually in twos or threes. They do not limit their attacks to the flocks of the immediate vicinity in which they are kept, but travel for miles in all directions, spreading destruction in the flocks with which they come in contact. Because their work is so often done under the cover of darkness it is almost impossible to catch them in the act of worrying the sheep, and hence they can seldom be positively identified.

"The ways in which different dogs attack and destroy sheep vary greatly. Some dogs simply kill one or two sheep in a flock, while others continue the attack until all the sheep are either destroyed or crippled. In many cases where large numbers are killed they are neither bitten nor wounded, but simply chased until they die from exhaustion.

"After a dog has once formed the habit of killing sheep, it seemingly becomes a mania with him, and he is seldom, if ever, broken of it. He not only destroys sheep himself, but leads other dogs to the work. No consideration should be given such dogs; if additional losses to flocks from this source are to be avoided, they should be dispatched as soon as their habits are known."—V. O. McWhorter, *Animal Husbandry Division, U. S. Department of Agriculture.*

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APPENDIX

Variability in the Radish

(*See article on page 357*)

TABLE I.—*Comparison of Variability in Characters*

	Scarlet Globe	White Box	White Icicle
Weight (in grams)			
Mode	10.5	3.8	30.5
Modal coefficient	17.00%	18.35%	12.31%
Mean	12.58 ± .3192	17.22 ± .5044	47.59 ± 1.392
Standard deviation	6.285 ± .2243	11.49 ± .3573	26.34 ± 1.023
Coefficient of variability	49.15% ± 2.34%	66.7% ± 2.850%	55.34% ± .882%
Length (in millimeters)			
Mode	35.5 and 29.5	30.50	112.
Modal coefficient	13.00% and 16.75%	13.56%	13.40%
Mean	34.488 ± .4378	29.42 ± .326	124.55 ± 1.393
Standard deviation	8.62 ± .3077	7.43 ± .231	34.22 ± 1.023
Coefficient of variability	25.00% ± .9978%	25.25% ± .834%	27.55% ± 1.952
Thickness (in millimeters)			
Mode	29.50	38.50	29.
Modal coefficient	15.00%	11.02%	19.56%
Mean	27.295 ± .319	31.53 ± .417	54.35 ± .279
Standard deviation	6.279 ± .224	9.50 ± .295	6.86 ± .205
Coefficient of variability	23.00% ± .904%	30.13% ± 1.019%	12.62% ± .383%
Index of shape (length divided by width)			
Mode	1.02	.86	4.32
Modal coefficient	21.00%	27.65%	15.94%
Mean	1.354 ± .062	.97 ± .009	4.25 ± .046
Standard deviation	1.223 ± .044	.213 ± .007	1.129 ± .034
Coefficient of variability	90.39% ± 5.27%	21.96% ± .715%	26.55% ± .853%

TABLE II.—*Correlation of Weight with Length and Thickness*

	Scarlet Globe	White Box	White Icicle
Weight with length	.6506 ± .0215	.8258 ± .0140	.8840 ± .0378
Weight with width	.8810 ± .0394	.9013 ± .0083	.8740 ± .0311

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